

# Mechanical World

## AND ENGINEERING RECORD

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# ROCKFORD

## POWER TAKE-OFF ON A PORTABLE AIR COMPRESSOR

This 'Bristol' portable air compressor plant has several interesting features.

A Dorman 6-cylinder engine of 9450 c.c., running at 1,400 r.p.m., drives a double-acting two-stage compressor with two pairs of cylinders set at 90° to give perfect balance.

The drive from the engine to the compressor is taken through a Rockford power take-off unit incorporating a heavy duty 11½" twin-plate over-centre clutch.

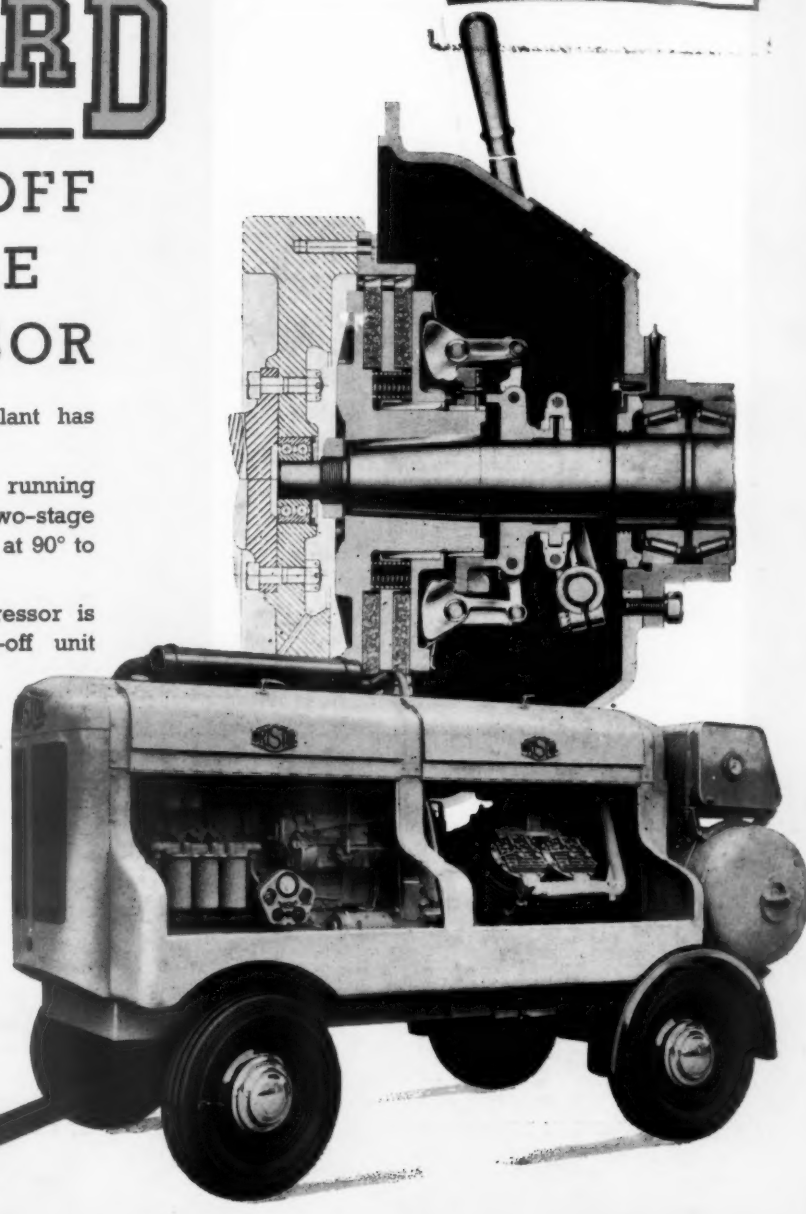
Rockford high-duty clutches and power take-offs are made in an extensive range of sizes, all having the advantage of the 'over-centre' type, free from running thrust except during the moment of operation.

*Full particulars on application  
of Rockford products  
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**BORG & BECK COMPANY LTD**  
LEAMINGTON SPA, WARWICKSHIRE, ENGLAND



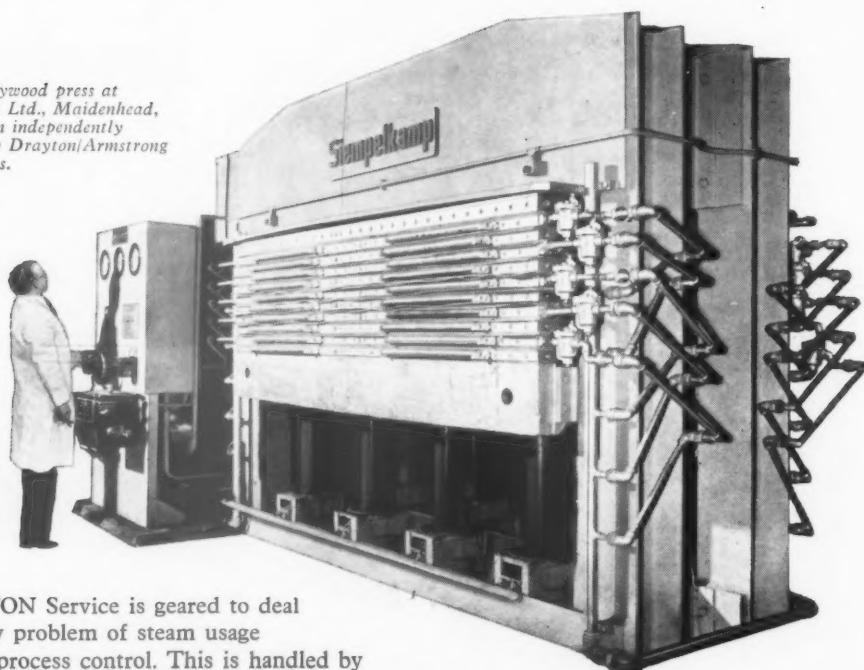
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# DRAYTON SERVICE

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A. Harvey Ltd., Maidenhead,  
each platen independently  
trapped by Drayton/Armstrong  
steam traps.*



DRAYTON Service is geared to deal with any problem of steam usage or heat process control. This is handled by technicians with considerable practical experience, who are backed by a range of equipment of outstanding reliability and efficiency. The comprehensive service includes pre-sales consultation, planning and after-sales service as well as the supply and commissioning of equipment. Tell us your requirements or write for the Drayton Catalogue to Dept. MW

**Drayton  
Manufactures  
Include :**

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- Automatic control schemes for heating and air conditioning
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## Machine Tool Universe

TO make almost anything these days for a commercial market requires machinery, and to make anything to supra-human accuracy cannot be done without the specialized machinery which alone makes it available. This mechanical frontage over the whole face of industry has one and only one support—the machine tool: indeed, in many places the machine tool is also the direct means of production. Thus while all the machinery and plant used in industry is made with the aid of machine tools, some consumer products come directly from machine tools. Therefore not all machine tool users are engineering works making machinery of other descriptions for industry generally: it is not so long since, for instance, that fountain pens were turned on lathes, and of course motor car manufacturers use machine tools in large quantities on a product which, like the fountain pen, goes direct to the consumer.

While the machine tool industry has an undoubted compactness, it displays variety in a number of ways, principally in purpose, in precision and in service. In purpose there is every known way of cutting or forming material; in precision there is every degree from a bold ruggedness to continuous electronic control, and in service every method from the leisurely experimental to completely programmed automatic production—and in some cases the latter is accompanied by economy irrespective of quantity, which is a complete reversal of what was established thinking as lately as only a few years ago.

A gradual innovation in recent years has been the incorporation of a considerable degree of flexibility in many basic types of machine tool. For instance, the unit system permits of the building of a machining group up to any required degree of complexity, and equally important in this connexion is the attention which has been given to the design of basic machines whereby the customer can specify just what he requires the machine to do, and pay for that and no more.

The useful life of machine tools is so long that it would be safe to say that most of those in use throughout the world are out-of-date by comparison with the new machines of today. A new machine is expensive and it has either to recover its cost quickly by a rate of output so high that the machine can be replaced in the future (the near future perhaps) by its inevitably more productive successor, or, if it is not required for continuous use, it must keep its standard of precision over many years so that its annual cost is reduced to an economic figure.

In the light of the points discussed it is clear that matching the output of machine tools to demand is a tricky business. Comparatively few attempts at line production have succeeded, yet a fairly high degree of standardization is customary. It is characteristic of the industry that it keeps well ahead in development and that it plans continually for the future while it produces for the present. Experience has led to output being regulated to an average domestic level of demand, leaving occasional excess and specialized demands to be met from abroad. Since this, more or less, is also the practice elsewhere in the world the industry has an international character too. This element of universality is in time with the march of progress in this rapidly changing world.

# LOG SHEET

## Logical Design of Computers

The new MUSE computer, now under development at Manchester University, will complete the addition of two numbers in one ten-millionth of a second. This was stated by Dr. T. Kilburn, Reader in Electronics in the University, at a symposium on Logical Design during the British Computer Society's Cambridge Conference.

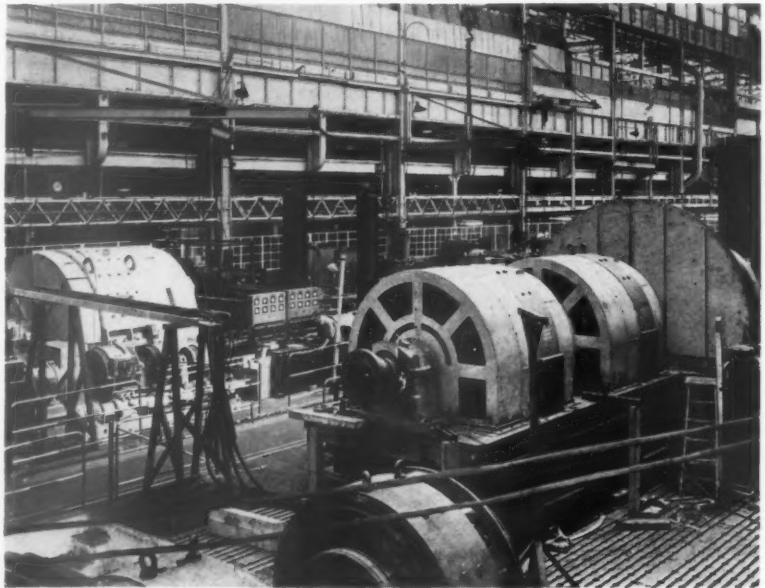
This high speed is achieved by a transistor circuit invented by Dr. Kilburn, which transmits the carry-over from one digit position to the next at a quarter of the speed of light. The mean rate of obeying instructions from the core store will be about 700,000 per sec. An important feature of the computer will be a fixed store of 8000 words (with an access time of 0.13 microsecond) which will hold many routines concerned with programmed arithmetic and the organization of transfers to and from magnetic tape and other input and output media.

Dr. M. Lehman of the Israel Ministry of Defence, explained how he and his colleagues had been able to plan a computer using only \$12,000-worth of equipment. He analyzed the cost of commercially available machines, concluding that materials accounted for only about 10% of the price. His computer is intended for general, "open-shop", scientific computing and will have an 8000-word drum and a 128-word core store.

Dr. N. C. Metropolis, Director of the Institute for Computer Research at the University of Chicago, described a computer being built in his Institute modelled on Maniac II at the Los Alamos Scientific Laboratory. The new machine will have 8000 or 16,000 words of core store with a cycle time of only two microseconds, and four magnetic tape decks. He also described an interesting form of floating point representation of numbers that will be used in the computer. This will avoid the appearance of large numbers of meaningless digits at the end of approximate numbers, whilst retaining a few guarding digits against rounding errors.

In the discussion which followed, Dr. A. R. Edmonds (London Uni-

versity) asked Dr. Kilburn whether the order code of MUSE had been planned bearing in mind that perhaps 80% of the programmes would probably use some kind of autocode. Dr. Kilburn replied that this was certainly envisaged, as it had been with Mercury, and that the sub-routines in the fixed store, and the large number of index registers (128), were intended to assist in the use of an autocode.



**MACHINERY FOR INDIA.**—This view of equipment for Durgapur (India) Steelworks on test at Metropolitan-Vickers Trafford Park Works shows, at right, the flywheel motor-generator set for the structural mill roughing stand (two 1200-kW dc generators at near end), and at left, the 2500-hp driving motor for the structural mill roughing stand, with (in front) the main exciter set and amplitudyne exciter set

## Rocol Progress and Products

The new premises of Rocol Limited at Swillington, near Leeds, comprise a factory, administrative buildings and laboratory, all built on a concrete raft to guard against subsidence caused by colliery workings.

The company has pioneered the development of molybdenized lubricants and has had many notable successes in providing the means of successful lubrication in extremely difficult conditions. For instance, Rocol provided the Mount Everest Expedition with watch oils, and other lubricants for the South Pole Expe-

dition. In the machine tool field, the cutting, reaming, tapping and drilling of alloys of great hardness or brittleness was overcome by Rocol developing the "R.T.D. Compound".

The first Rocol product was anti-scuffing paste and the word "anti-scuffing" was coined by Rocol. This paste is now used in thousands of workshops all over the world.

Progressing from this paste, Rocol has produced during the past five years molybdenized greases, suspensions in spirits, oils and water, compounds with synthetics, varnishes and aerosol sprays, with the result there are now 38 different Rocol

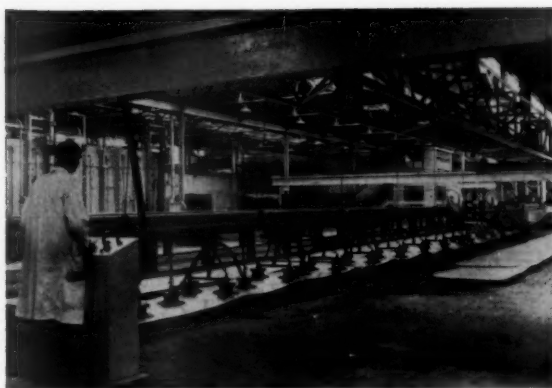
products incorporating molybdenum disulphide.

Britain's first atomic power station at Calder Hall experienced great difficulties in the control gear of the reactor—it was rusting up and the lubricated bearings were not working. An urgent call was made to Rocol and a new lubricant—water repellent and able to withstand atomic radiation—was found in three days.

## Fatigue of Structures

A committee to review current research needs on the fatigue of engineering structures and to survey existing research facilities, has been set up by the Council for Scientific and Industrial Research following an approach from the Institution of Civil Engineers. The committee will not include aircraft structures, re-





Left, the King "Mansaver" grab carrying aluminium slabs for the next process. Right, the King overhead de-piling crane ready to lift a single slab

inforced concrete structures, or metal physics in the scope of their review, though information gained in these fields will be used. The committee's terms of reference are:

"To review current research needs on fatigue of engineering structures (metal), to survey existing research facilities and to make recommendations to the Department of Scientific and Industrial Research."

The committee is interested in examining records of failures or accidents which might have been due to structural fatigue, even if fatigue was not recognized as the initial cause. Such information may be helpful in revealing areas in which further research work is needed.

Professor Sir Alfred Pugsley, of the Department of Civil Engineering, Bristol University, has been appointed chairman. The other members of the committee are: Sir Donald G. Bailey, Mr. T. Baldwin, Mr. H. L. Cox, Mr. O. A. Kerensky, Mr. H. M. Pemberton, Mr. C. E. Phillips, Professor S. C. Redshaw, Dr. P. B. Walker and Dr. R. Weck.

## Handling Aluminium Slabs

Larger and heavier aluminium slabs are now being handled at the Banbury Works of Northern Aluminium Company Limited by two mechanical lifting devices made by Geo. W. King Limited, Stevenage, Herts. Slabs of up to 85 ft length singly and in batches of up to forty are lifted by the King "Mansaver" grab and taken from one rolling process to another, either directly or via an annealing furnace.

The King Mansaver is an electrically operated grab of 10½ ton capacity, having thirteen pairs of load carrying legs spaced at 6 ft centres

and supported by two double channel load bearing beams running the full length of the grab. The load beams are attached to the outer end of seven pairs of opposed rack beams running between cast iron flanged rollers; these are motor driven for opening and closing to suit the width of the load through totally enclosed worm gear units and chain incorporating a slipping clutch to give motor overload protection. The whole grabbing unit is integral with a 72-ft box lattice girder arranged for two-point suspension from an overhead travelling crane whose operator controls all grabbing and travelling operations. Both the grab and lattice girder structures are constructed of 95% aluminium alloy sections.

At one stage each slab is lifted separately from the batch and placed in position for intermediate rolling, and for this purpose Geo. W. King Limited have designed and installed an overhead de-piling crane which, by the use of rubber suction discs, lifts a single aluminium slab swiftly and safely from the top of the pile.

The King de-piling crane comprises a lifting beam, which also acts as a suction manifold, to which forty-four suction discs are attached by load bearing chains and connected by flexible air hose. A vacuum pump creates the necessary suction when the discs make contact with the aluminium slab, and the whole beam is hoisted by ten wire ropes attached to separate drums mounted on a common shaft located within the box lattice framework of an 87-ft span electric overhead travelling crane.

All, or just isolated groups of suction discs may be used according to the length of slab being handled. Each disc is also fitted with an auto-

matic cut-out to prevent loss of vacuum should an irregular size of slab cause failure to contact. All crane and vacuum motions are controlled from a desk at floor level where the operator has a full view of the area served by the crane.

## Remotely Controlled Fire Fighting

News of a remarkable fire fighting appliance designed to deal with fires occurring with crashed aircraft but which obviously has further possibilities, comes from a U.S. concern, The Solar Aircraft Company. It is in the form of a guided missile which is launched like a rocket and which hovers like a helicopter.

Known as the Firefly, it can reach anywhere within five miles in 40 sec. It is fired and guided by push buttons and when it reaches the scene, the unmanned craft turns into a helicopter and hovers over the area. Then the remote operator by using a switch can release more than a ton of extinguishing liquid over the area before the flames can get out of control.

The Firefly looks like a small jet aircraft with helicopter blades in its tail and a fire nozzle in its nose. A solid propellant rocket under the fuselage shoots the missile into cruising altitude. When in flight, it operates as a fixed wing aircraft. The three rotor blades are locked back to serve as tail surfaces. The Firefly is transformed into a helicopter by unlocking its rotors and firing small rocket motors in each rotor blade tip.

The missile-helicopter reaches its goal in three flight stages: (1) a ballistic trajectory; (2) powered level flight and glide, and (3) deceleration and hovering. It picks up commands

from a remote operator through an electronic "brain", and translates these into mechanical control of its devices. Radar and electronic sensing devices in the vehicle enable the operator to discover where and how severe a fire is and where and how much fire extinguishing fluid to release.

### **Lighting Heavy Engineering**

Some 18 months ago Head Wrightson & Company Limited, Thornaby-on-Tees, formulated new building policies incorporating re-lighting of heavy engineering shops and drawing offices. This equipment, supplied by Siemens Edison Swan Limited, has now been installed, and now the heavy plate shop, which makes large steel vessels for the atomic energy programme and which is one of the most modern of its kind in the country, is illuminated by 23 blended light units, each with two 400 watt mercury fluorescent discharge lamps type MBF/U and one 1500 watt tungsten lamp. Fittings with control gear are mounted above the crane rail and are maintained from the crane. Illumination is 12 lumens per sq ft at floor level.

Two drawing offices, one a new building the other existing, employ Sieline trunking. The older building has five rows of trunking at a height of 7 ft 6 in. above floor level to give an average of 25/30 lumens per sq ft at drawing board level. The new drawing office, slightly smaller, has a similar installation.

### **Mineral Insulated Thermocouples**

British Insulated Callender's Cables Limited, who have for some time been manufacturing mineral insulated cables are now applying the principle of mineral insulation to thermocouple production. The thermocouples consist of two dissimilar thermo-electric conductors, welded together at a point (the hot junction), embedded in highly compressed magnesium oxide insulant, and completely encased in a seamless, circular, stainless steel sheath.

When heat is applied to the hot end a small voltage is generated, and detected, via a compensating lead, by a suitable measuring device. This voltage is proportional to the temperature causing it and thus the meter can be calibrated to provide a direct temperature reading. The posi-

tive conductor is of nickel-chromium alloy and the negative conductor of nickel-aluminium alloy.

In the standard hot junction the conductors are welded together, and the sheath is welded over to form a hermetic seal completely insulated from the conductors. This does not increase the overall diameter of the cable or make installation any more difficult. For the first time thermocouples of all sizes down to 0.060 in. dia can be supplied with an insulated junction.

### **Pipe-handling Tractor**

The first pipe-handling tractor of its kind to be made in the U.K. has been supplied by Michigan (Great Britain) Limited, of Camberley, Surrey, to the Shell-BP Petroleum Development Company of Nigeria Limited.



This, the first pipe-handling tractor to be built in the U.K., will be used by Shell-B.P. in the oilfields in the Niger Delta. It is seen stacking lengths of heavy pipe during a demonstration at Shell Haven Refinery, Essex.

Known as the "Michigan" 175A pipe handler, the machine will be used to speed up operations in the materials yard, at pipeline construction jobs and drilling locations. It is designed to lift a load of 14,000 lb of tubulars in lengths up to 40 ft and travel with them as required. Since it will load and unload a 50,000 lb pipe-carrying trailer and tow it at speeds up to 27 mph—according to the terrain—considerable saving of conventional transport and handling equipment will be achieved.

The machine is powered by a supercharged Rolls Royce C4S diesel engine with a power train embodying a torque convertor, power-operated gear change and four-wheel drive; power steering is also incorporated. Extra large tyres 18.00 x 25 permit it to operate on soft ground.

The pipe-handling forks are designed to tilt forward at 72° under hydraulic control, which enables pipe to be picked up from a point 3 ft below ground level—a valuable feature when barges have to be loaded or unloaded. With the pipe-handling mechanism removed, the machine can also be used as a heavy duty fork lift truck.

### **Electrification in Kent**

A considerable quantity of equipment has been supplied by the British Thomson-Houston Company Limi-

ted for the electrification of the Kent Coast lines of the Southern Region of the British Railways, the first phase of which has been brought into service. The equipment includes high-voltage switchgear and high-speed d.c. circuit breakers installed in eight substations and eight track paralleling huts in the first phase.

The high-voltage switchgear is metal-clad Class MF.36, 33 kV, 750 MVA, exactly similar to the 106 equipments supplied by BTH for the Southern Region Change of Frequency Scheme, from 1953 to 1957. Thirty-one equipments are involved in this phase.

Eighty-one high-speed circuit breakers have been supplied, the track feeder breakers being rated for 750 volts, 3000 amp d.c., and the rectifier breakers for 5000 amp. The track feeders are an improved version of the type supplied for the Change of Frequency Scheme, but the rectifier breakers are of the new latched design which retains the same characteristics as the magnetically held breakers, and are mounted in the improved trucks.

For ease of maintenance and testing, all the high-speed circuit breakers are truck mounted, plug-in type, the trucks being provided with rubber-tired wheels.

Large numbers of a.c. and d.c. switchgear equipments are being manufactured for the second phase of the electrification scheme.

### Computer Serves Office and Factory

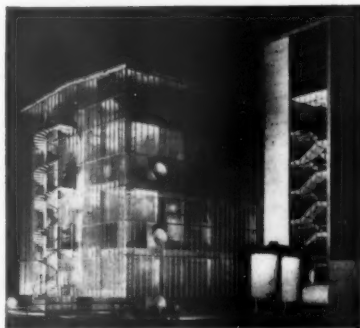
An example of evolution in management accounting through conventional punched card data processing to the integrated use of an electronic computer is the case of Crosfields & Calthrop Limited, the Liverpool manufacturers of animal foodstuffs. In 1951 the company installed Hollerith punched card equipment to deal with invoicing, sales statistics, ledger posting and the calculation of agents' commissions. These machines enabled Crosfields & Calthrop Limited to cope with a considerable increase in business without further increase in clerical staff or office space. Now, however, a new £50,000 I.C.T. Type 1202 computer installation will not only take over all the existing punched card work on the office side but it will also be used on the production side and in particular for the linear programming of animal foodstuff mixes.

The exact calculation and rigorous control of mixes is of the greatest importance in animal foodstuffs production. A particular type of food may contain a number of ingredients, the prices of which vary according to market movements. In prescribing a mix the object is always to obtain the best possible product of the highest nutritional value at an economic cost. Trial runs at the I.C.T. Computer Centre have already shown that the computer can arrive at the optimum mix very much more speedily and accurately than can be achieved by other methods of computation and will ensure that all nutritional requirements are fully met. The com-

puter will also be invaluable for dealing with the considerable volume of calculations necessary to interpret the results of the latest research.

### CIBA Anniversary

CIBA (A.R.L.) Limited, manufacturers of synthetic resin adhesives, celebrated the 25th anniversary of its foundation earlier this year. The company was formed in 1934, under the name of Aero Research Limited, by Dr. Norman A. de Bruyne, lecturer and demonstrator in mechanical sciences at the University of



The new CIBA factory for making Araldite epoxy resins, part of a £500,000 extension to the works of CIBA (A.R.L.) Limited. Other new premises are laboratories for long-term research and a new sales block

Cambridge. The purpose was to undertake research, particularly into aircraft structures, and production of resins began on a commercial scale in 1937. The company became a member of the CIBA organization in 1947, and shortly afterwards a large factory for making urea-formaldehyde and melamine-formaldehyde resins was built. The company is now the biggest producer of synthetic resin adhesives in the United Kingdom.

The anniversary celebrations included the official opening of three new buildings, which have cost £1M. They are a factory for making Araldite epoxy resins, laboratories for long-term research and a new sales block.

### The Ubiquitous Tornado

The origin of the Keith Blackman Company goes back to the year 1823—136 years—when Mr. James Keith of Arbroath, Angus, founded his industrial gas, heating and hydraulic engineering company. In the year 1900 his business joined forces with the fan manufacturing concern of the Blackman Ventilating Company Limited and it is in its capacity as

makers of the "Tornado" range of fan engineering equipment that British and overseas industries identifies the name Keith Blackman.

Representative of the range of "Tornado" products which are used today in virtually every industrial and commercial undertaking—in shipping and mines, in textile and chemical industries, in general engineering and foundries, in office blocks and public buildings—was the display on Stand No. 24, Grange Avenue, at the Scottish Industries Exhibition, Glasgow. Exhibits of particular interest were: the recently introduced Aristocrat centrifugal fan for heating and ventilating, air conditioning and general applications; the 19 in. Type AFX axial fan for general industrial and marine ventilation purposes; the 18 in. Type APA propeller fan, one of a large number of units held in stock to meet immediate needs where large volumes of air have to be moved efficiently and quietly under free air or slight resistance conditions; a two-stage, 20 in., Type 8, cast iron blower; the Type AR(W) aerofoil section, backward bladed centrifugal fan impeller of high efficiency and low sound level; the bifurcated axial type fan with the driving motor outside the airstream and within a chamber formed by bifurcating or splitting the casing; and one of the Extravent range of window-mounted fans.

### "Dicrom" Metal Diffusion

Some interesting results have accrued from the development of "Dicrom", the metal diffusion process introduced last year by Metal Diffusions Limited, 292 Worton Road, Isleworth, Middlesex. The process, which uses chromium, is characterized by the deep penetration possible and the high chromium content at the surface. So marked are these features that Mr. E. G. Weatherley, the company's technical works director, has succeeded in producing this chromium sheet by, in effect, replacing iron sheet by the diffusion of chromium into it, the result being a chromium sheet of 96% purity.

The depth of diffusion obtained with the process depends upon the composition of the metal treated, but is between 0.001 and 0.015 in. The chromium at the surface is always above 60% and resistance to temperature and oxidation is therefore high. The range of possible application is obviously considerable.

# Packaging

## —a specialized branch of mechanization

THE provision of commodities in packaged form arose in the first place as a necessary accompaniment to the marketing of products of controlled quality and quantity so that they reached the hands of the final purchaser with both these attributes unimpaired. In recent years the practice has expanded enormously and now encompasses a great variety of products from perishable goods to hardware, and to the original purposes have been added others, not least those of attractiveness and convenience. The change has come about through the development of materials and equipment which enable packaging to be used economically and often embodied with advantage as part of the production line. It is not our purpose here to treat the subject exhaustively, but to describe some of the exhibits at the recent Packaging Exhibition with a view to illustrating some of the trends in this ancillary branch of mechanization.

Cardboard boxes, cartons, and display covers (or "outers") for boxes and cartons, are used to contain a great variety of products. The boxes or cartons first appear from automatic machinery as blanks, either printed or plain, and if the latter they usually require a printed outer cover. The blanks may be made in the manufacturer's factory or, perhaps more usually, they

are supplied ready cut, and printed if necessary, by a specialist boxmaker. Converting the blanks into boxes (Fig. 1) can be done quite quickly by hand, but a machine such as the Foldmaster (Fig. 2) does it much more quickly—at upwards of 2000 per hr. It is operated by compressed air with foot pedal control. One obvious advantage of the high rate of output is that box folding can be related to the demands of the production line without any necessity to provide storage for made-up boxes.

Sewing has long been used for securing the heads of bags whether of hessian or multi-wall paper, and it continues in popularity. The sewing heads are installed as part of the production lines with platforms geared to the high speed at which these machines work. A new Union bag closing unit may be fitted to a new style floating bag carrier platform or directly to conveyors. The machine can be set to produce double lock stitch or single chain stitch. To suit the high speed of the mechanism, lubrication is by an enclosed system and other special features are the chain cutter, "throw-out looper" to facilitate threading, and tiltable feed dog. The machine is also made in the form of a suspended head with balancer.

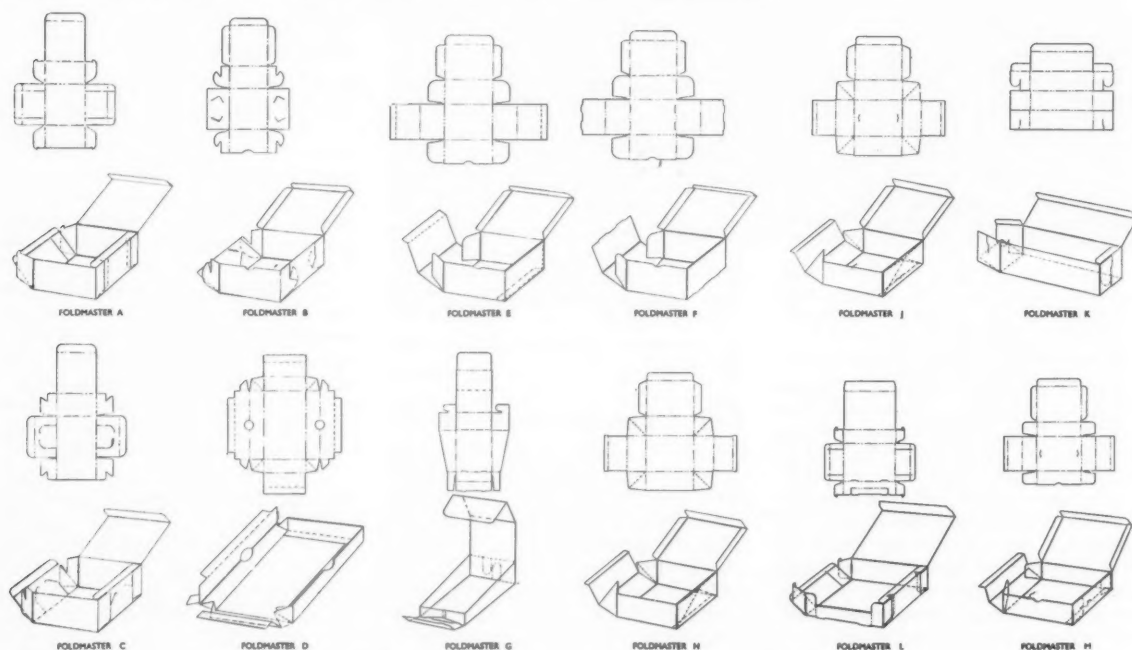


Fig. 1.—Blanks for cardboard boxes and the ways in which they are folded





Fig. 2 (left).—Converting blanks into boxes at 2000 per hr on the Foldmaster machine

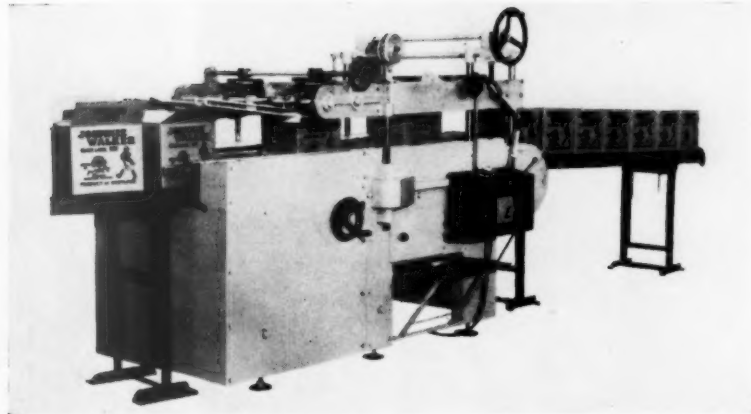


Fig. 3 (top right).—Musketeer carton taping machine

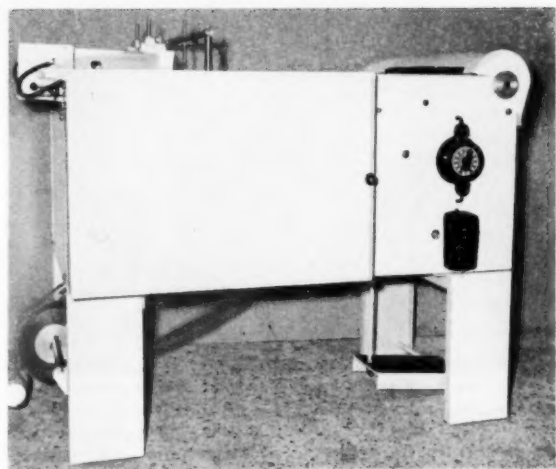


Fig. 4.—Clement machine for wrapping objects of regular shape in heat sealing material

The glued and taped carton is a very secure package. The Musketeer Mark III machine (Fig. 3) is very compact, being only some 8 ft by 4 ft, and has a glueing unit which accepts cartons with the top flaps open and quickly glues them down. The glueing rollers have a clutch mechanism which ensures that they are in constant rotation, thus avoiding an excess of glue. The closed carton is then presented to the taping mechanism which applies a shallow U-seal of tape to the top of the carton whilst it is under compression to ensure a tight, compact package.

The electrostatic properties of the vinyl tape employed keep the tape against the steel applying pads so that it is always in position ready for application to the next carton. The tape is severed after each operation by a hot-wire cutting device which gives a clean, straight edge and a secure seal. Adjustments for variations in carton height and width can be made very quickly. The machine deals with from 14 to 20 cartons per minute.

The tape used is 5-Star Vinylprint, a printed vinyl tape which is tough and waterproof and has special "non-easy tear" edges. It has excellent printing quality and is customarily used bearing an advertising message.

Heat sealing wrapping material has greatly altered the marketing of products in small quantities, and products which, like miniature bearings, are of small size. It is also much used for powders and liquids and as an exterior wrapping for packets. The Clement machine (Fig. 4) wraps objects of regular shape either singly or in groups, in heat sealing wrapping material. The wrapping cycle has two simple operations, one manual and one automatic. The former is the sleeve wrapping of the packet and the latter consists of unrolling the paper, cutting off and end sealing. Packets are wrapped and sealed as quickly as the operator can pass them over the machine.

The Wetzel strip packing machine (Fig. 5) seals small articles like tablets singly into endless strips of heat sealing material in such a way that each item occupies its own capsule. The rate of packing is up to 1500 per min. A vibrating feeder conveys the product to a separat-

ing mechanism controlled by a Geneva cam. Sealing is done by crimping rollers which have cartridge heaters fitted to them. The strip can be divided, perforated in either direction and provided with notches for easy opening. The cutting-off is electronically controlled as also is the registration of any printing in relation to the sealed capsule. The machine is versatile, tablets from  $\frac{3}{16}$  to 1 in. dia being accommodated as well as powder, granules and liquids.

A useful and attractive feature of much packaging is the colour printing of wrappers, cartons and labels. The colours are applied separately which means that register must be accurate.

The "Trakatron", a machine for guiding webs of material for slitting or re-reeling, controls the position of the parent reel either by a servo motor or a hydraulic system operated by electronic circuits. The machine will track either to the edge of plain materials or to pre-printed materials, using either a special tracking line or the printed pattern itself. The "Autotron" is a photo-electric equipment which automatically maintains accurate colour register on rotogravure presses, and the "Multinex Universal" is a fully automatic step and repeat machine for the production of labels: it produces either multiple negatives or litho plates.

The "Idotron" continuously reading colour monitor used to maintain consistent colour and density control on

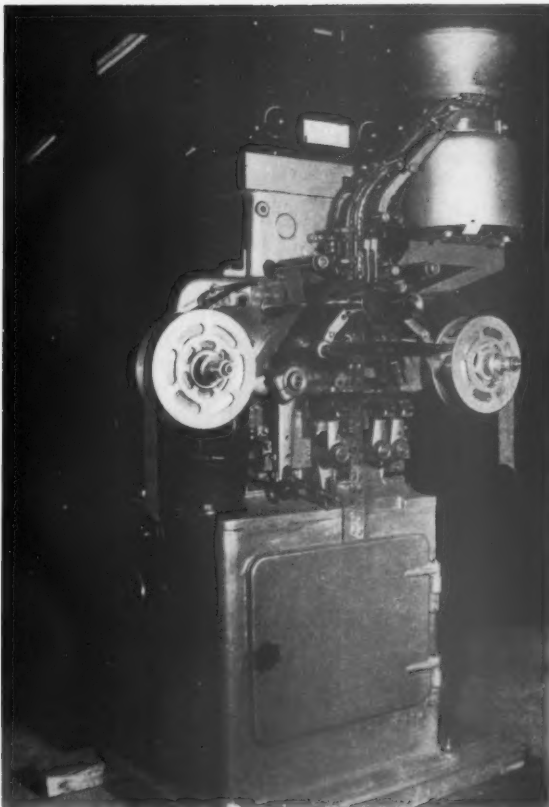


Fig. 5.—Wetzel strip packing machine for capsule sealing

multi-colour rotogravure machines has lately been developed for use with sheet-fed machines, and particularly litho machines.

The scanning head contains a lamp from which a light spot is imaged down vertically on to the sheet and the diffused reflected light is collected by an optical system and directed on to a photocell. The photocell produces a sequence of electrical voltages which depend on the "white" background of the paper, the "reflectance value of the colour mark", and a "black level", so that the white to ink reflectance measurement is compared with a scale provided by the white to black measurement. From the signals obtained, steady voltages are produced which are passed on to a meter panel. When the machine minder has reached his pass copy, the meter is set to zero, and, in effect, the machine minder is storing the required-ink film density value in the equipment. Thus, when a variation in ink film density occurs, this appears as a deviation from zero on the meter. This deviation voltage is then used to operate the control mechanism. The method of control used at present is automatically to hold off the vibrator roller from the duct roller when the ink density increases and automatically to increase the number of teeth on the duct feed when the ink density decreases.

Liquids and powders are packed in lidded or capped containers, nowadays entirely by automatic machinery without spillage or dust. The range and versatility of these machines is well illustrated by the Albro fillers which range from a small single-head hand-operated bench type to high-speed fully automatic models. Among

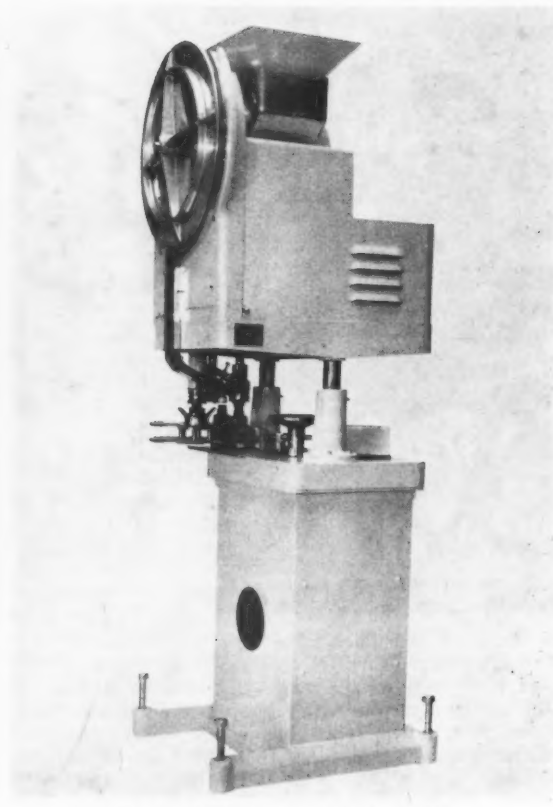


Fig. 6.—Albro fully automatic capping machine

the latter is a 15-head fully automatic filler for depositing French mustard into jars at the rate of 120 per min. A powder filling machine, also with 15 heads, is vacuum operated and dustless and has a speed range up to 150 per min when handling 2-oz and 4-oz cans.

Paints, varnishes and enamels are commonly filled into cans by gravity and are often weight operated, the machines used being of various sizes down to a small pedal-operated volumetric machine. A new volumetric machine is the Albro type T.C. and is for filling containers up to one gallon. It works on a time control principle and deposits accurate quantities irrespective of weight, shape, or size of the container and it can therefore be used for filling plastic bags and the like.

Fully automatic and semi-automatic capping machines (Fig. 6) are found in the Albro range, and also a machine for applying visk rings to the tops of wine bottles, semi-automatic lidding machines and machines for putting corks into bottles.

Perishable foodstuffs, mostly fruit and vegetables, are largely packed for transit in wooden crates. These are usually supplied in the "knocked-down" form for convenient storage and are put together as required for filling. A quick way of securing the corners is by wire stitching. The new No. 60 Rapidex machine will stitch wood of up to  $\frac{5}{8}$  in. thickness without corner posts, or  $\frac{1}{4}$  in. with posts. It uses 20 and 21 gauge wire and operates at variable speeds up to 200 stitches per minute.

An important auxiliary in packaging is the loose packing required to fill the spaces between an irregular product and the rectangular walls of the container. A



Fig. 7.—Bandashred industrial paper shredder

machine (Fig. 7) which converts all types of waste into protective packing while at the same time solving the problem of removing bulky waste paper, is the Bandashred industrial paper shredder. It is electrically operated so there is no smoke and no burning, and therefore eliminates the need to send waste materials outside smokeless zones for destruction.

Waste paper, cardboard, corrugated board, cellular wadding, crêpe and latex rubber can be fed into the machine either vertically or along a feeding tray. It comes out the other end, into a receptacle provided with the machine, finely shredded into wool for packing—particularly suitable where breakable products are handled. If the packing material is not required at the premises where the machine is installed, transportation, baling or even selling is made cheaper since all waste material is reduced to one-third of its original bulk.

The Bandashred also has the great advantage of disposing of plans, blue-prints or confidential documents which are no longer required.

The ready use of bags, whether of polythene, multi-wall paper or cellulose, for packaging has largely been made possible by bag-sealing machines. For example, the "Sticla" machine (Fig. 8) will seal bags of any length up to 40 in. and of any width at the rate of 20 ft per min. An adhesive tape is used, with or without a ripcord as desired, and the seal is actually stronger than the materials generally used for bag making. A useful feature of this tape sealing is the absence of bunching of the bag material at the neck. This maximizes the useful space of the container and minimizes the bag material.

A particularly delicate packaging operation is egg sorting, grading and packing. The new B.D.R. machine (Fig. 9), while still in prototype form, has proved to be very successful and production models are expected next year. The handling rate of the prototype is 7200 eggs an hour, a rate decided by the ability of an operator to inspect the eggs as they pass through the candling

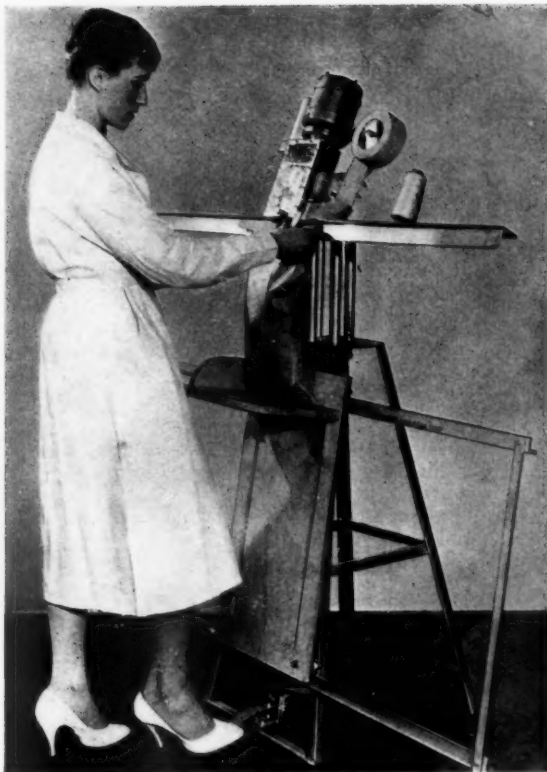


Fig. 8.—Sticla bag sealing machine

section. Considerably higher rates are expected with the production machines.

Six trays of eggs are placed at a time on the feed-in conveyor and 15 sec per tray is available for the operator not only to pick out any bad "leakers" but also to adjust any eggs which are not facing points down before reaching the loading position. Normally eggs are de-crated but it is possible to unload from the egg box direct.

The vacuum loader has four arms each with six automatically controlled vacuum suckers. As one arm is picking up six eggs from the Keyes tray the preceding arm is depositing six eggs on to the main candling conveyor.

On the candling conveyor the eggs revolve both in clockwise and anti-clockwise directions whilst passing over the lightbox, an action which simulates the hand candling process of twisting an egg before a lamp. Any faulty eggs are rejected by the candling operator and placed into appropriate divisions. The eggs then pass on to the limit of the conveyor where they are transferred to a circular grading turntable equipped for ejecting super-large eggs then grades progressively "Large", "Standard", "Medium", "Small" and "Extra Small"; stamping the eggs with the grade is automatic.

Automatic packing is achieved with the aid of a "memory unit". An electrical impulse controls the egg from the time it is graded until it is dropped into its appropriate grade section. Each impulse sends its message to a bank of distributors mounted above each particular grade section on the packing conveyor. All eggs are ejected at one point, a transfer turntable accepting the

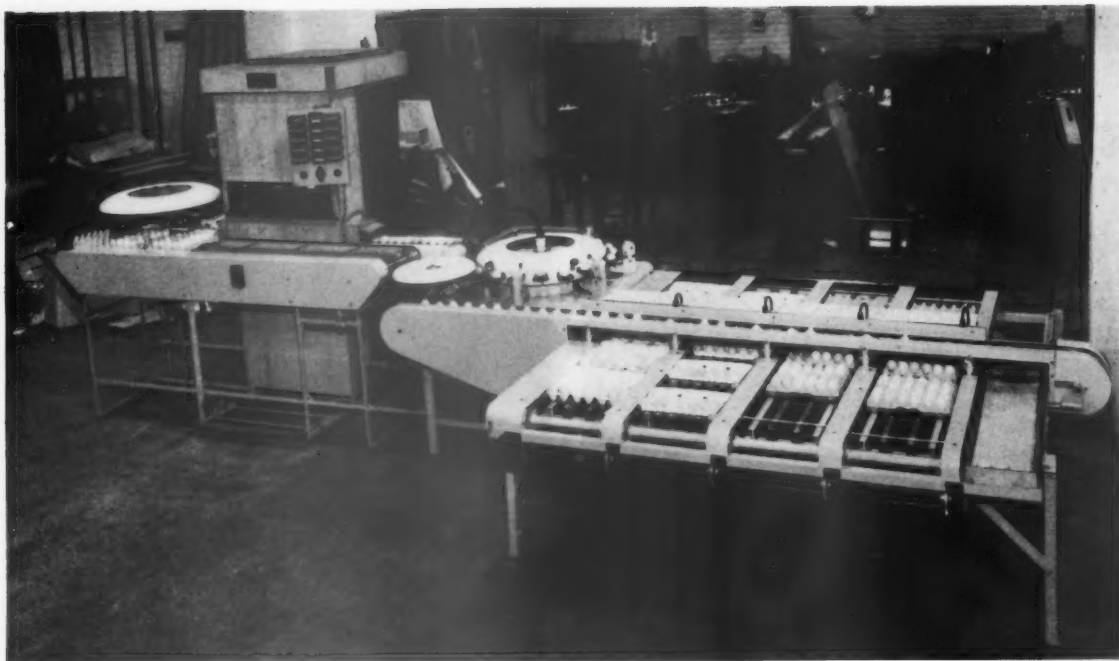
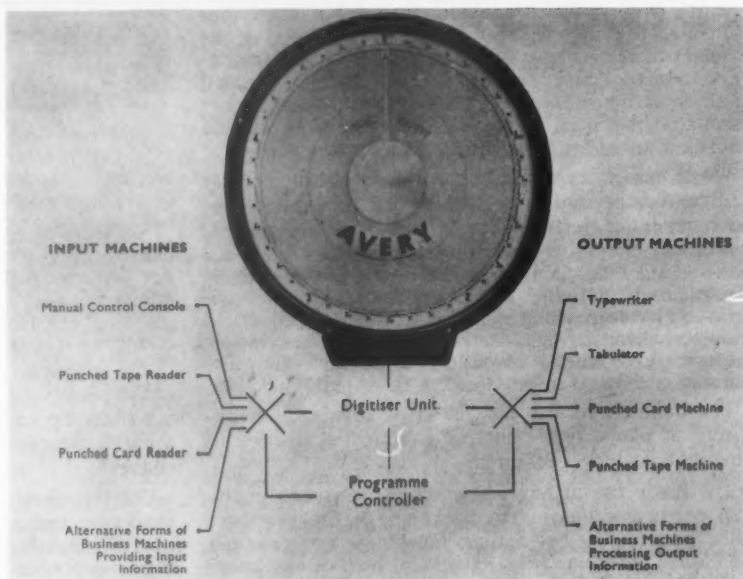
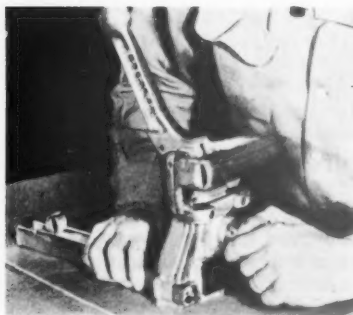


Fig. 9.—(above) Egg sorting, grading and packing on the B.D.R. machine.

Fig. 10.—(below) Hand-operated Bostitch machine for stitching cartons from the outside

Fig. 11.—(right) Sequence of operations of Avery automatic weighing control



eggs and delivering them into cups on the endless chain. The distributor, having been instructed by the "memory unit", trips cams which interfere with the passage of the cups, opens them and allow the eggs to drop into position in the tray or retail pack.

Cartons in many sizes are in wide use for transporting goods and quantities of smaller packs. Among the various secure methods of fastening cartons so that their strength will be maintained during handling and transport, is wire stapling. The Bostitch machines illustrate the variety of ways in which this can be done and the speediness of the operation. The pedestal type machines have various arrangements of the overhead arm and the

clinch blade to suit work on putting together and closing cartons, and they are foot or electrically operated, the latter by foot switch so that with either type the operator has both hands free for manipulating the carton. Incidentally, these stapling machines are used for many other purposes, including manufacturing processes where stapling is a suitable means of fastening parts together. The way in which a closed carton can be stitched entirely from the outside is illustrated by a hand-operated machine (Fig. 10) which inserts wide crown staples either right through the flute boards and turned in, or clinched "blind" within the thickness of the lower board, the adjustment for penetration being





Fig. 12.—RB non-lubricated rotary air pump for use with packaging machinery

under a simple knob control while the tightness of the clinch is automatically adjusted for any setting.

From the point where raw materials are received, to the point where finished products leave a factory, weighing stations are usually positioned at necessary points for purposes of control. Ultimately for accountability purposes, control can relate to stores received and issued, the measurement of scrap metal, the checking of machining operations, the filling of containers, the check-weighing of packages, and the selection and feeding of ingredients into a mixing process.

The latest development of weighing machines as a control factor is the electrical linking of dial scales with one or more of any of the available standard business machines, such as listing and totalizing machines, automatic electric typewriters, tape perforators and card punch machines—all of which can be remotely situated.

The applications of this principle are diverse and adaptable to particular needs. The accompanying diagram (Fig. 11) illustrates the sequence of operations in the Avery automatic control. Following initial push-button operation, the programme controller actuates the digitizer unit, and completes the circuits linking the input machines to the analogue generator in the dial indicator, which then receives its instructions and commences the weighing operation. The weighing cycle completed, it reports to the digitizer unit, which breaks the input circuits and completes the output circuits, causing the factual information to be passed to and recorded by the output machines. The cycle of operations can, if required, be repeated any number of times, without further manual interference.

The basic principles of the Avery automatic controls are approved by the British Board of Trade. They offer many advantages to modern business and manufacturing organizations—errors are virtually eliminated, secrecy of formula is maintained, change-over to a different cycle of operations is achieved in seconds, and there is a direct link with fully mechanized accounting machines.

Packaging, like every other industry apparently, requires pumps. Pressure and vacuum are both needed and there is, in addition, the need for cleanliness, which usually means freedom from contamination by lubricating oil. An illustration of how these requirements are met is provided by the new RB non-lubricated rotary air pumps (Fig. 12) with displacements from 6 to 55 cu ft per min, vacuum down to 24–26 in. Hg and pressure

up to 10–12 psi. They may be used for vacuum alone, pressure alone, for vacuum and pressure simultaneously, or for pressure and two independent vacuum circuits simultaneously.

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- Avery weighing controls.—W. & T. Avery Limited, Soho Foundry, Birmingham 40.
- Bandashred paper shredding machine.—Block & Anderson Limited, 58 Kensington Church Street, London, W8.
- BDR egg packing machine.—Brecknell, Dolman & Rogers Limited, Pennywell Road, Bristol, 5.
- Bostitch stapling machines.—McGarry & Cole Limited, 33–37 Alfred Place, London, WC2.
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- Musketeer carton sealing machines.—John Gosheren & Co. Limited, Albert Embankment, Vauxhall, London, SE11.
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- Trakatron, Autotron, Multinex and Idotron colour controls.—J. F. Crosfield Limited, 2 Elthorne Road, London, N19.
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## Porous Plastic is Tough, Light and Inexpensive

After extensive research and development a new porous plastic material with many possible uses is being manufactured by Pritchett & Gold and E.P.S. Company Limited, Dagenite Works, Dagenham Dock, Essex. Produced from high density polyethylene of the Ziegler type, the new material, Vyon, has already found applications in air and liquid filtration, air fluidized powder conveying, and as aeration pads and electrolytic diaphragms. Although the material is tough and flexible, it is also light and easily fabricated. It is machinable, and can be welded and drilled. A permeable material of medium pore size, its permeability is uniform and can be controlled in manufacture.

The advantages of Vyon for filtering are that it is light and strong and therefore easy to transport and manipulate; it is easily engineered and fitted into plant and equipment. It is said to be inexpensive and to have excellent chemical resistance to a wide range of aqueous solutions.

When used in liquid filtration, it offers complete freedom from detachable fibres, and its smooth surfaces facilitate mechanical cleaning. In many filtration applications it can be used unsupported.

When used for air fluidized powder conveying, the material is hygienic and offers uniformity of air distribution, which is an essential factor for efficient conveying. Its non-absorbency combined with its immunity from infestation makes it of particular interest to the food industry for powder conveying.

It is naturally water-repellant, and is therefore suitable for use as an aeration pad as its non-absorbency makes it difficult to clog.

As an electrolytic diaphragm its mechanical strength is of great importance, and its flexibility makes it easy to bolt or slide into tanks. It is not fragile and need not be handled or transported with special care.

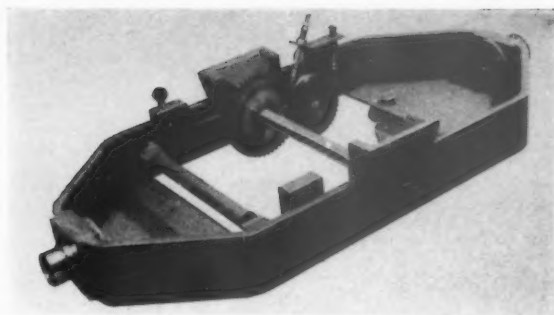


Fig. 1.—The bobbin cradle fitted with an independent tensioning device. Note the guide box to facilitate location of the shaft on two running rollers and the self-acting lock which is easily released to withdraw the bobbin

## Wire Rope Manufacture

### *A new 24 in. bobbin high speed tubular strander*

When considering new machines, wire rope and electric cable manufacturers look ahead of their present requirements towards schedules based on the higher demands of future markets. In 1910, when Larmuth & Bulmer patented the first high speed tubular strander, this factor was not forgotten and machines of this type have coped with production demands for many years. In developing a new high speed tubular strander this company has, therefore, retained this basic principle of operation but has incorporated many new features further to increase rotational speeds and to assist greater production by easing operational control.

The first LB machine to incorporate these new features is the 24 in., 6 plus 1 bobbin strander. In this machine much attention has been given to the simplification of loading as it is recognized that production time can be lost on this operation. A new type of bobbin cradle has therefore been designed as shown in Fig. 1. To facilitate easy loading, the bobbin shaft, seen in position, simply drops on two running rollers by the aid of a guide box to locate the shaft correctly. An automatic locking device holds the bobbin shaft firmly in the cradle. An independent friction tensioning device is fitted to each bobbin cradle to simplify tensioning adjustment and to avoid the constant dismantling of tensioning assemblies incorporated on the conventional drum. For quick wire threading, the wire guide tubes are conveniently placed outside the tube rotor and ample access is given at the nose section for wire manipulation. An improved die box assembly, Fig. 2, is fitted for quick action in opening and closing the die and to simplify adjustment of the die. The haul-off capstan is cantilever constructed with a single bearing mounting to give uninterrupted access for the necessary turns around the capstan wheel. Depending on the material to be processed, the capstan will be provided with either a fleeting ring or fleeting knife. As an alternative to the single drum capstan, a double drum V-groove capstan assembly can be supplied. Totally enclosed change gears for altering the lay are supplied or, alternatively, time in setting up a machine can be greatly reduced by a multi-speed gear box which can be fitted to simplify the lay adjustments.

For maximum speed operation at 650 rpm the tube rotor is dynamically balanced under simulated operating

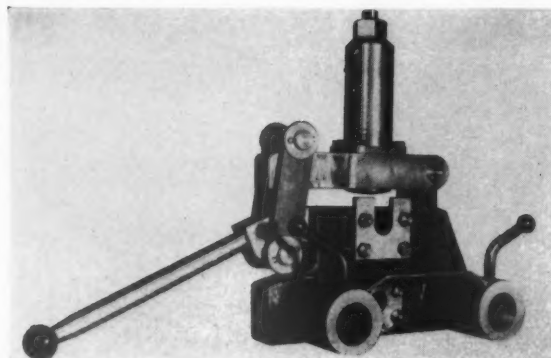


Fig. 2.—The improved die box assembly is quick acting for opening and closing the die and assists easy adjustment

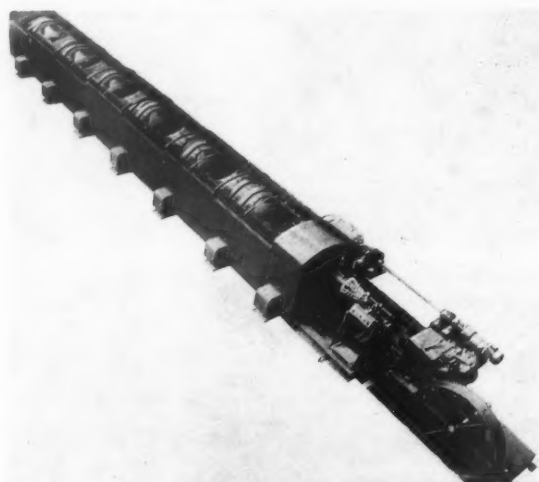


Fig. 3.—The new LB high speed 24 in. 6+1 bobbin tubular strander runs at 650 rpm. Many new features are introduced to ease loading and operational control. The machine presents a neat appearance with sliding type guards and convenient placing of electrical and lever controls. The illustration shows a preforming device fitted to the machine

conditions. This is achieved with the use of a unique high speed balancing machine which has been devised to detect any centrifugal out-of-balance forces which are then corrected to reduce excessive strains and injurious vibrations. Attention has been given to the construction of the tube rotor and a two-port bobbin access has been chosen to provide the rigidity needed for high speed running. The support mounting for the tube is carefully aligned. Because of the care taken in the construction of the tube, it can, in consequence, be mounted on silent, hard wearing rollers running on roller tracks. These rollers have outstanding abrasion resisting qualities and high tensile strength to prevent flats developing during operation.

Where required, the automatic stop mechanism is of the "lashing" type with quick positive operation. The "lashing" ring at the nose section is positioned to brake the machine before the wire enters the die box.

For the production of flattened strand, the machine is fitted with an external revolving core section and synchronized forming rolls.

The makers of the machine are Larmuth & Bulmer Limited, Audenshaw, Manchester.

## Permanent-electro-magnetic Chuck

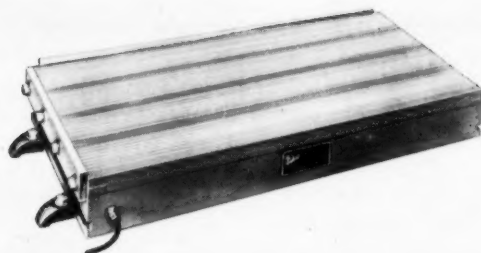
A major development in work holding practice was the introduction of the Eclipse permanent magnet chuck by James Neill and Company (Sheffield) Limited. Now, after 25 years development, the company has made another significant contribution to the subject in the form of a permanent-electro-magnetic chuck. This chuck, which is the subject of British Patents 633, 608, 758, 183 and others pending, operates on the principle that the highest possible efficiency of a permanent magnet is to be found before the circuit in which it is magnetized is broken, as it is then that it is operating at its full value or remanent magnetism ( $B_{rem}$ ).

In construction the chuck has a number of permanent magnets surrounded by coils which magnetize the magnets to saturation, *in situ*. In this manner the magnets attain a high point of efficiency securing the workpieces in contact in the firmest manner, as both the holding magnets and the workpiece are magnetized together. When the workpieces are to be removed from the chuck surface this is accomplished by reversing the current which, in effect, demagnetizes both magnets and workpiece alike. The operation of magnetizing or demagnetizing is effected merely by pressing the appropriate push button on the control equipment.

A further feature is the patented construction of the workholding surface. By laminating pole pieces and spacers of varying thickness, the reluctances of the gaps are graduated, the relatively narrow pitching greatly facilitating the holding of thin materials whereas by keeping the total reluctances of all gaps relatively high the "magnetic throw" thus provided is of such power as has never been previously achieved. This greatly assists the holding of rough parts or difficult materials.

The control equipment, including the necessary rectifiers, can be supplied as a self-contained unit or made available as a panel to mount alongside other control gear. It is designed to make and break on the a.c. side of the circuit thus eliminating certain difficulties associated with inductive loads. A short pulse of current is applied only when either magnetizing or demagnetizing, leaving the opera-

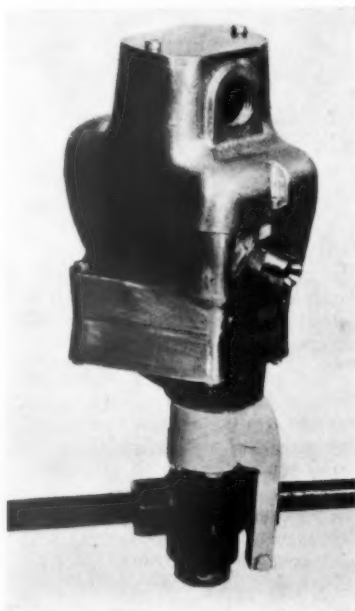
In the new Eclipse chuck the permanent magnets are surrounded by coils which secure maximum magnetization with workpiece in place



tion of work holding to be provided entirely by permanent magnets and therefore independent of power supply when in use.

The chuck is entirely independent of power supply whilst in operation so there is no danger of a "wipe-off" due to power failure. Furthermore, as the electric current is applied only during magnetizing or demagnetizing operations, there is no heat generated, thereby entirely overcoming the inaccuracies sometimes experienced with electro-magnetic chucks. The holding capacity is not limited by the power supply as the permanent magnets operate at the highest possible point of magnetic efficiency when the current is switched off.

This new chuck is listed in no less than 16 sizes, being grouped in widths of 12 in., 16 in., 18 in., and 20 in., and in lengths varying from 24 in. up to 40 in. By using units in parallel a very wide range of table sizes is provided.

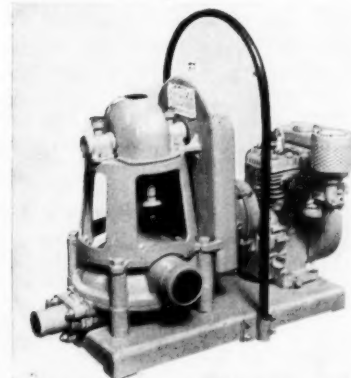


Kinetrol electro-pneumatic actuator mounted on a standard type of steam cock

## Electro-pneumatic Rotary Actuator

The Kinetrol rotary actuator will turn valves, flaps, cocks and other contrivances through a right-angle and back again in response to an electric signal switched on and off. It provides an effective substitute for the use of a man's wrist and it can exert about the same torque. In cases where solenoid valves are unreliable or of insufficient power this compact and inexpensive actuator will give a strong and positive action, working on the plant air line usually available at 80–100 psi. It will tolerate a temperature of 200° C, the materials will not corrode and a small integral filter prevents the ingress of dirt. The single rotary-vane piston design gives small overall size and the bolting flange is readily adaptable to a variety of requirements. The torque is 150 lb-in., the angular travel 90°, the input air pressure 80–100 psi, the electrical input, 230 volts a.c. or 12 or 24 volts d.c., the inlet air union is 1/4 in. B.S.P., the output shaft 3/8 in. square and the overall dimensions 3.9 in. x 4 in. x 5.5 in.

The actuator is a product of Kinetrol Limited, Trading Estate, Farnham, Surrey.



MUDLITE PUMP.—The new Mudlite pump, model M.1, is powered by a Clinton four-stroke petrol engine, has a 2 in. clip-on suction and 3 in. clip-on discharge with a maximum output of 2,500 gph. It is an inexpensive and reliable equipment which can be maintained at low cost. It is made by Auto Diesels Limited, Uxbridge, Middlesex

## Quick and Accurate Sheet Levelling

The latest precision levelling machine in the range made by The Bronx Engineering Company Limited, of Lye, near Stourbridge, is of the 17-roll type and has triple banks of back-up rolls fitted to the upper and lower work rolls. It will handle mild steel sheets up to 6 ft wide and of 10 gauge thickness.

All the rolls are of carbon chrome steel, the work rolls being of 2½ in. dia hardened to 85/90 scleroscope, and the back-up rolls, which rest in the work rolls and run in needle bearings, are hardened to 78/80 so that they cannot mark the work rolls. The top bank of rolls is arranged to tilt and adjustment is provided on the back-up rolls under the lower work rolls so that pressure can be directed to the sheet wherever it is required. Indicators are provided to show the roll position. At the inlet side of the machine these are power driven heavy pinch rolls for feeding strip from the coil.

The housings throughout are of heavy steel welded box sections, and the gearbox is also of welded steel. All



This new levelling machine handles sheet up to 6 ft wide and 10 gauge thickness at speeds of about 40 ft per min. There are triple backing rolls top and bottom, in needle bearings

the gears are self-lubricated and all the bearings are fed with oil from a mechanical lubricating system.

Drive is from a 35 hp slip ring motor which has a reversing starter. The levelling speed is approximately 40 ft per min.

## Level Measuring with Variable Control

A new instrument for controlling the level of free-flowing solids and liquids has been introduced by Thomas Industrial Automation Limited, Station Buildings, Altrincham, Cheshire. Named the "Leveltron", the instrument is capacitance operated and is distinguished by its stability. It provides continuously variable differential control over a range of 1-40 pf (pico-farad) by adjustment of two simple controls, the first of which sets the control point of the relay and the second is then used to vary the reset point without affecting the setting of the control point and so fix the differential as required. This arrangement permits of adjustment to obtain the best conditions for each application, permits also of subsequent adjust-

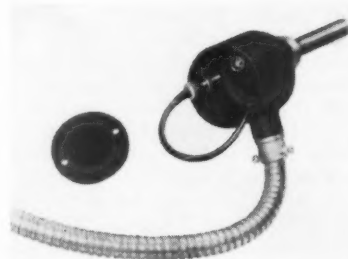
ment to suit changes in plant conditions, and often enables one instrument to be used where two of the fixed differential type would be required.



Heavy industrial model Leveltron

The relay current is "triggered" to provide a snap action of the relay without chatter or creep, and the design ensures negligible drift of control point or differential for wide variations in supply voltage, ambient temperature and humidity.

The measuring unit is in the control box, which may be anything up to 60 yd from the electrode, connection between the two being by co-axial cable and a patented transmission link system which minimises the non-working capacitance of the cable. Having the measuring unit in the control box instead of on the electrode has the advantages of protecting it from a dusty or injurious atmosphere, and protecting

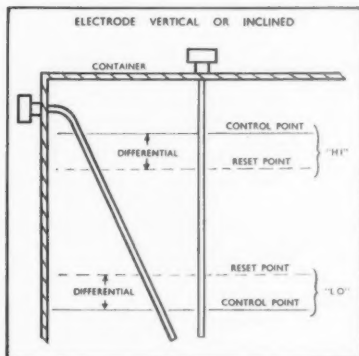


Standard electrode head showing simple plug-in connection

it from vibration, while at the same time providing easy accessibility. High or low level operation is obtained by use of a simple selector, and a reversible plug gives choice of direct or reverse mode of operation.

There are three basic instruments—general purpose, heavy industrial, and remote control models, each with a choice of supply in the range 110, 240, 440 V a.c., 40-60 cps. Electrodes have been developed to meet the majority of industrial applications: among them is a new one for use in level detection of all kinds of powder and granular material, even if of low dielectric. This electrode is also suitable for use with liquids of fairly high viscosity.

Power consumption is 10 watts for the general purpose model and 13 watts for the heavy industrial model. The price range is £26 to £46 per instrument.



The new Leveltron instrument provides a choice from a differential range of 1 to 40 pf



# Descaling Application and Formulation

*The heating of metal and metallic parts frequently produces oxidation and scaling of the surface, as when steel is forged, rolled, or heat-treated in a furnace. The presence of such oxides and scales may seriously affect later working processes and impair the finish of a part, since not only may portions of the scale be forced into the metal by the pressure of forging hammers, rolls, dies, etc., in forming and shaping operations, but also the presence of particles of oxide or scale may on occasion make grinding or machining costs to remove them excessive.*

VARIOUS methods have been devised for cleaning metals, and one of these is sodium hydride cleaning, which has a vigorous reducing action and therefore facilitates the cleaning process. Moreover, a great advantage of sodium hydride is that after the metal has been removed from the cleansing bath, the hydride does not attack the surface of the material. It is, therefore, a safe and effective medium and can be employed for the treatment of most metals, the only exceptions being those that themselves react with the type of alkali used as a carrier for the hydride, or which have properties such that immersion in a hot bath of hydride at the necessary temperature—in the region of 370°–400° C—may cause them to suffer damage. Even so, if the alkaline reaction is not rapid, the sodium hydride cleansing treatment can still be used as long as immersion is for only a brief period, assuming such a period to be adequate for removal of the scale or oxide.

The effect of the hydride bath is to eliminate oxidation scale at a relatively rapid rate, but this is not true of all metals. For example, some of the stainless irons which have been heated in strongly reducing atmospheres may show a type of scale that is extremely resistant to hydride cleaning. On the whole, however, the treatment will serve most of the metal user's needs.

The hydride is not used by itself, but must be an ingredient in a liquid bath containing a carrier, such as fused caustic soda. The amount of the hydride added to this is approximately 1½ to 2% by weight. The use of the term "added" is perhaps incorrect here, because in fact the hydride is formed in the bath itself. This is done by the reaction of metallic sodium and hydrogen in open-bottom chambers, known as "generators", and partly immersed in the bath. The metallic sodium is in the form of solid blocks either 2.5 or 5 lb in weight, and these are introduced at carefully spaced intervals into the generators. The generators themselves are placed either at the extremities or at the sides of the tank holding the solution, whichever is found more advantageous. The hydrogen gas is led in close to the bottom of the generators and its rate of flow is appropriate to the rate at which metallic sodium is added. Some users prefer to employ dissociated anhydrous liquid ammonia in preference to hydrogen.

Sodium hydride does not attack the metal itself so there are no pock-marks on the surface of the treated metal, and once the scale or oxide has been removed,

the bath does not attack other layers. This absence of attack means that pickling losses are greatly reduced. The temperature of the bath rarely exceeds 370° C and this temperature has virtually no effect on the micro-structural condition of the material being descaled.

Not only are almost all steels readily descaled by this process, but in addition such metals as the high nickel alloys, nickel itself, copper and Stellite can be commercially treated. When iron castings are treated in the sodium hydride bath, particles of sand embedded in the surface or lurking in pockets or recesses are easily eliminated.

The chemical basis of the process is represented by the equation  $2\text{Na} + \text{H}_2 = 2\text{NaH}$ . The consumption of the necessary materials is broadly 1 lb sodium to 7.8 cu ft hydrogen or 12 to 15 cu ft dissociated ammonia. As has been seen, the hydride is formed in the generators; is quickly taken into solution by the caustic soda; and as it rises from the bottom, is dispersed evenly by normal convection processes over the entire volume of the bath. There is no turbulence of gassing, so that noxious or inconvenient fumes or vapours are not produced, and therefore the expense of providing a hood for the apparatus is not incurred.

The chemical basis of the attack on the scale is shown in the following equations:  $4\text{NaH} + \text{Fe}_2\text{O}_3 = 4\text{NaOH}$ ;  $\text{NaH} + \text{CuO} = \text{Cu} + \text{NaOH}$ ;  $\text{NaH} + \text{Cr}_2\text{O}_3 = 2\text{CrO} + \text{NaOH}$ . The last of these equations is illustrative not of a complete but of a part reduction only. To put the action of the descaling agent in ordinary terms, the hydride produces either a metal or a lower oxide from the scale, at the same time forming caustic soda, which is itself the carrier for the hydride and therefore does not constitute an impurity.

In using the sodium hydride descaling process, the work is first racked or introduced into special baskets. As long as the liquid is able to circulate freely round the metallic surfaces to be cleaned, no special care is necessary in placing the work in the baskets or on the racks. The work is allowed to remain in the bath for a period ranging from 8 to 20 min according to the amount of work to be cleaned, and the operator must work out for himself the best period for his particular needs.

After full elimination of the scale, the parts are taken out of the solution, set on one side to drain, and before they have become cold, are well rinsed in water,

the object of this immersion being to wash away a good deal of the reduced particles of scale. If it is found that some of the scale is still adhering, a vigorous hosing under high pressure will not only detach all the remaining material but will also clean away any caustic soda films remaining from the original immersion.

If it is desired that the material when descaled should have a bright surface, as may be necessary for some of the later mechanical working processes, the work is next immersed for a brief period in an acid bath, but this can be dispensed with if it is known that the work will be given special cleaning, or will be tooled or coated at a later stage. The operator should take care to wash away all traces of acid still clinging to the work, using a water hose, and in this way the metal will show a bright surface.

It must not be assumed that sodium hydride is the only cleaning agent for metals. Salt baths of other types have been and are being widely used for this work, one of the most important being the sodium hydroxide bath in which metals can be descaled, cleaned and improved. The basis of this process is the passing of a direct current through the bath. As a result, there is oxidation at the positive pole and reduction at the negative pole. The work constitutes one pole and the container of the bath the other. A reversing switch changes polarity as required. The metals to be descaled and the type of finish required govern the period of oxidation and reduction and their sequence.

Caustic soda itself is sometimes commercially employed as a bath for the cleaning of steels and non-ferrous metals. This type of bath contains an additive (not sodium hydride) and functions at a higher temperature (480° to 540° C) than the hydride bath. The composition of the additive is not known to the writer and is regarded as a trade secret. Another useful bath of relatively recent introduction is the nitrate bath for cleaning metal moulds. It is employed within the temperature range 320° to 430° C and its primary purpose is not to eliminate scale of the normal type, but to clean away residues of rubber, carbon black and lubricants from the moulds employed in forming rubber parts. These moulds may be of cast iron or aluminium, and are plunged into the bath and kept there for from ten minutes to half an hour, after which they are cooled off sharply in water.

The descaling of the stainless steels presents problems of some importance. Most commercial treatments for scale and oxide removal employ an acid, usually a solution of 8% to 12% (by volume) of sulphuric acid, and the first step in the process is the immersion of the metal in this bath for a period ranging from 10 min to 30 min, the bath being at a temperature of from 70° to 80° C. The precise duration of the immersion depends on the kind of scale to be removed, and the kind of steel on which it occurs. It is customary to add an inhibiting agent to this bath.

Some users prefer a solution containing 10% to 15% (by volume) of hydrochloric acid at a temperature of 50° to 60°, again employing an inhibiting agent. When the immersion period is over, the steel is thoroughly washed, whichever solution is used, and the next step is taken. This is to re-immers the work in a bath of 10% to 15% (by volume) of nitric acid to which is added from 1% to 2% (by volume) of hydrofluoric acid at a temperature between 50° and 60° C, the immersion period depending on the type of steel and the character of the scale. It varies from 10 to 20 min. After this second immersion, the work is given a hot water rinse and quickly dried, as this produces

the most satisfactory surface. The solutions may be contained in tanks suitable for strong acids, and when HCl is used, it may be advisable to have the tank lined with rubber.

Still dealing with the stainless steels, we must not overlook a type of descaling known as electrolytic pickling, which may be carried out in either nitric or sulphuric acid, the concentration being 6% to 10% (by volume) for nitric or 4% to 8% (by volume) for sulphuric acid. These tanks will suffice by themselves as long as the type of steel is a plain chromium/carbon steel; but for the austenitic stainless steels, a further immersion in a bath of 10% to 15% nitric acid with an addition of 1% to 2% hydrofluoric acid is necessary, the bath temperature being between 45° and 50° C. In this instance no electrolytic action is attempted.

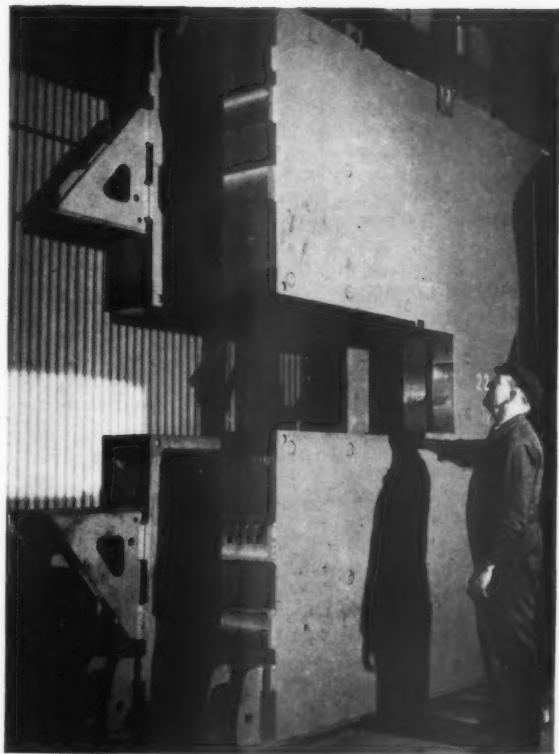
For the electrolytic baths the electrodes must be accurately positioned to induce the current in the work. This process is mainly confined to strip stainless material, and concludes with the usual wash and dry.

The austenitic stainless steels are often dealt with by immersing them in a different type of bath containing about 10% (by weight) of ferric sulphate together with from 1% to 2% (by volume) of hydrofluoric acid. Alternatively, about 5% to 10% of ferric sulphate can be added to 8% to 12% sulphuric acid solution, the bath being maintained at a temperature between 50° and 60° C. This treatment should not be used for the straight chromium stainless steels unless they have previously been immersed in 8% to 10% (by volume) sulphuric acid solution at a temperature between 70° and 80° C. No inhibiting agent is required for any of these stainless steel baths. The ferric sulphate bath is also useful as a finisher after the descaling of carbon and alloy steels in caustic.

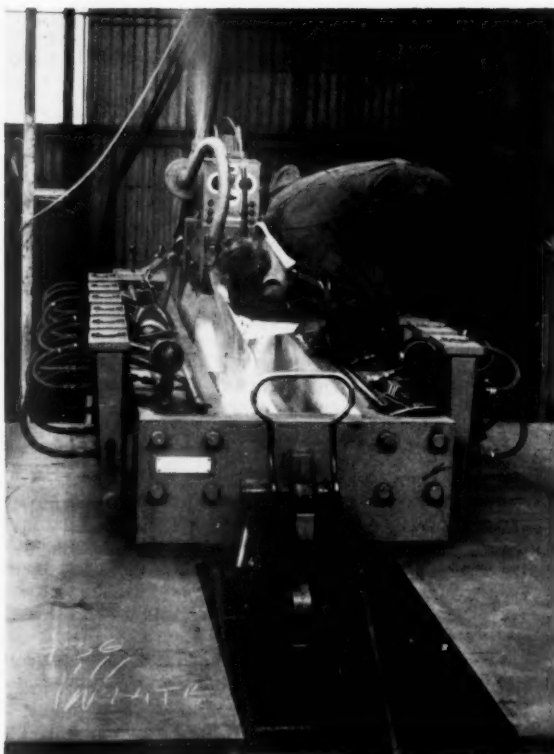
Still dealing with the stainless steels, we may mention that the sodium hydroxide, sodium hydride salt bath process is also effective. In this instance the solution contains about 98% (by weight) of sodium hydroxide and 2% (by weight) of sodium hydride, the temperature of the solution being between 400° and 430° C. According to the kind and quantity of scale, the work may be immersed for as little as five or as much as 15 min. After immersion it is washed in water and immersed for a further minute or two in a 10% (by volume) solution of sulphuric acid at 70° to 80° C, including an inhibiting agent. After a further rinse, the work is immersed in a bath of 7% (by weight) nitric acid and 1% (by weight) hydrofluoric acid at 70° to 80° C and a final rinse completes the process.

For descaling stainless steels in caustic soda, which can be done, the immersion lasts for from 2 to 15 min, according to the amount of scale present, and the bath temperature ranges from 480° to 540° C. A water rinse is then followed by a dip in weak hydrochloric or sulphuric acid to  $\frac{1}{2}$  to 1 min. If the surface is desired brighter than is achieved by this descaling, a quick dip in weak nitric or nitric/hydrofluoric acid may be employed.

The descaling of nickel and nickel copper alloys can be carried out by the methods suggested for the stainless steels, but it is often found that the surfaces so produced are not bright enough for the ultimate purpose. In these instances it is advisable to give the work a 1 to 2 min. dip in a hot solution of 10% nitric acid at a temperature of about 70° C. Alloys of nickel and molybdenum can be given a brighter surface by dipping them in a hot bath of 8% sulphuric acid and 0.2 lb NaCl per gal of mixture, keeping the bath at a temperature of about 90° C.



Two of the 20 ton magnet sectors (there are 336 in all) for the 7000 ton magnet core.



A specially developed jig to weld two five-foot plates together. The plates are held together by evenly distributed clamping pressure of 60 tons, which pre-bends the plates so that distortion results in a flat plate.

## Processes in the Manufacture of the Harwell Proton Synchrotron Magnet

*The 7000 ton magnet is built up of plates with a high degree of accuracy at every stage to secure the precision required in the finished apparatus. The requirements of all stages were unusual and manufacture had to be preceded by much fact-finding investigation. The magnet is due for completion next May*

A 7000-ton core of an electro-magnet—the biggest in the British Commonwealth and heaviest in Europe outside the U.S.S.R.—is now being built at Manor Works, one of the Wolverhampton factories of Joseph Sankey & Sons Limited for the National Institute for Research in Nuclear Science, which this year celebrates the first anniversary of the granting of its Royal Charter.

The complete magnet core, which has to be accurate in parts to 0.005 in. is a unique engineering feat, for besides the phenomenal accuracy and rate of production required for such a massive product, neither the plant was available nor the method of manufacture proven when the contract was accepted.

Completed, the magnet ring will be 160 ft dia, but because of transportation and installation problems, it is being produced in 336 sectors, at the rate of one a day,

each sector weighing nearly 20 tons and tapered to one half of one degree at the rear to ensure perfect fit. The last sector should be finished in May, 1960.

Each magnet sector stands 10 ft 5 in. high, is 9 ft 3 in. wide and 12½ in. thick and is made from 45 silicon steel plates, each of which has to be flawless, level and completely insulated from its neighbour.

The winding is designed to concentrate the magnetic field between the poles of the magnet and keep a powerful beam of atomic particles in its correct path.

The magnet sectors, which cost a total of £1,500,000, form the largest component part of the £7,000,000 7 GeV proton synchrotron—a 7000 million electron volt “atom smasher”—being built at the Rutherford High Energy Laboratory, Harwell, for the National Institute for Research in Nuclear Science.

The synchrotron, when completed in 1961, will be



Britain's most powerful tool for fundamental research in nuclear physics, and is being built by the institute to provide universities and other institutions with facilities and equipment which are beyond their reach, both financially and physically.

Production of the magnet sectors is a joint project between Sankey's Albert Street Works at Bilston and Manor Works, Ettingshall, Wolverhampton, with teams from both plants liaising for the development work and the solving of the numerous problems.

The difficulties were many. A continuous production line was necessary; all the plant was specially ordered or developed, manufactured and sited for the one job; handling problems meant all operations had to have their own handling and lifting tackle.

A year was spent finding the correct annealing process so that the steel plates met Harwell's strict requirements for accuracy and magnetic properties; a new welding machine was developed with another company as each plate for the magnet sector was formed from two welded sections—no sheet steel large enough being made in Britain.

The temperature for each 20-ton sector had to remain constant to within three-quarters of one degree Centigrade during the final machining as any variation from this temperature would cause the machined surfaces to be inexact. The slightest error is very serious as the throat of the C-shaped magnet has to be accurate to 0.005 in. and both faces no more than 0.004 in. out of flat or out of parallel to each other.

This accuracy is necessary as the throat of the magnet carries a vacuum tube through which a beam of protons (atomic particles) is accelerated to a velocity of just under the speed of light ( $0.99 \times 186,271$  miles/sec in vacuum). The protons are injected in a very short time into the magnet ring from a subsidiary accelerator of 15 million volts and are accelerated for seven-tenths of one second. During that time they will have travelled round the magnet ring a distance equal to nearly four times round the world.

On reaching maximum velocity the protons are "shot" at a target and the behaviour of secondary particles resulting from collisions between the bombarding particles and nuclei in the target material is studied.

At Harwell, the alignment of the magnet calls for an equally high degree of accuracy and skilled civil engineering. Specially designed surveying equipment will be used and data processed by a DEUCE computer at the National Physical Laboratory so that the magnet ring is placed accurately in its true plan position.

The salient features of the manufacture of the magnet are a very high rate of production of a massive product held to a very tight specification. This has necessitated a flow production line; all the plant has been specially ordered or manufactured and sited for the one job. As already mentioned, because of the tremendous handling problem involved all the operations have to have their own handling aids and lifting tackle, e.g. the whole of the preparation bay is served by roller conveyor, the shears have their own hoist and the two cranes are used only for placing material on the start of the line and on the trailer for removal.

In the annealing and finishing bays each operation has a crane or a shift of crane time allocated to it; except the  $\frac{1}{2}$ -in. shears and the D.R.N.S. stove which have their own hoists.

As examples of the tight tolerances, the following points are of note:

**Preparation bay.**—High quality welding, and weld dressing with very close attention to thickness of dressed plate.

**Annealing bay.**—Very high flatness standard after annealing. Close control of temperature of anneal both for the sake of electrical properties and for avoidance of thermal distortion.

**Shearing after annealing.**—To  $\pm 1/32$  in. on a 9 ft and a 10 ft dimension, including squareness.

**Defraying.**—Complete removal of all scale and surface defects.

**Insulation.**—High degree of insulation of each plate from its neighbours, each plate having an area of about 100 sq ft.

**Assembly and machining.**—Very tight dimensional tolerance. The worst is the 23.000 in.  $\pm 0.005$  in. with an overriding  $\pm 0.002$  in. tolerance on flatness and parallelism to each other of the active throat areas each 3 ft 8 in.  $\times 12\frac{3}{4}$  in.

### Manufacturing sequence

**Plate preparation.**—The  $\frac{1}{4}$  in. and  $\frac{1}{2}$  in. thick steel plates made of 1% silicon steel are each marked for cast, ingot and position of ingot. These are stored and then drawn from stores in such a manner as to randomize any variations within each cast.

A pair of plates are selected and inspected, two sides of each plate are sheared at right angles, the rough profile of the magnet throat is flame-cut and then the two plates are welded together to form a complete lamination.

The excess of the weld is dressed off flush and the lamination is ready for annealing.

**Inspection.**—Each plate is closely inspected for thickness variation, lamination (or pipe) and surface defects.

**Flame cutting.**—A magnetic head working from a dowelled template controls the profile shape which is cut at 120 ft/hr in  $\frac{1}{4}$  in. plate and 84 ft/hr in  $\frac{1}{2}$  in. plate, using  $\frac{3}{16}$  in. and  $\frac{1}{8}$  in. nozzles respectively. This profile leaves  $\frac{3}{16}$  in. for final machining.

**Welding for form laminations.**—When enquiries were first made about the fabrication of the magnet sectors out of 1% silicon low carbon electrical steel, using  $\frac{1}{4}$  in. thick lamination and  $\frac{1}{2}$  in. thick cheek plates, it was realized that two 5 ft plates would have to be welded together as it was impossible to obtain 10 ft wide plate.

The specification asked for weld metal to be approximately the same chemical analysis with 90% of the mechanical properties of the parent plate. The plates after welding must be flat without any puckering; welding must be to full penetration; and no undercutting at the edge of the welds and no thinning down of the plate would be permissible after the penetration and reinforcement weld metal had been removed by grinding.

To obtain these requirements, a special electrode was required, also a welding jig with heavy clamping and provision for presetting the plate to allow for welding distortion was necessary. As it was difficult commercially to obtain 1% silicon wire, the choice of the welding process was limited to submerged arc or a continuous electrode, where the silicon could be added in the flux.

At this stage, the Quasi Arc Company were consulted about the possibility of making a continuous electrode to give a 1% silicon content to be used with their CO<sub>2</sub> process. In a period of a few weeks an electrode was developed and test welds were made and approved by Harwell. When the order for the magnet sectors was placed with Sankeys, the Quasi Arc Company were



asked to submit a design for a welding jig to weld the two 5 ft plates together. The first design was rejected by Sankeys as being inadequate for the job, but a second welding jig designed jointly was agreed upon. This has a total clamping pressure of 60 tons which is distributed to twelve individual pads of 12 in. length, the bed girder being able to withstand these forces without distortion. Four removable water-cooled copper backing bars were made with a camber for the correct amount of plate deflexion to off-set welding distortion.

The close square butt type of weld preparation is used. Fusarc 8 swg continuous electrode is used as the filler material with a current setting of 540 amps at 28-30 volts. Welding speed is approximately 17 in. per min and full joint penetration is achieved; the cambered copper backing bar is also grooved ( $\frac{1}{4}$  in.  $\times$   $\frac{1}{16}$  in.) to assist in this connection.

With the  $\frac{1}{2}$ -in. thick plates, close square butt joints are again used, one pass being made from each side. The  $\frac{1}{2}$  in. plates are turned over for welding both sides in a special purpose manipulator designed by Sankeys.

In the early stages of production, trouble was experienced with transverse cracks and fissuring. This trouble was attributed to the high silicon and low manganese content of the steel, but a satisfactory electrode was evolved which gave welds entirely free from cracks and the weld metal analysis was approved by Harwell. Ardrex dye penetrant is used as an inspection method.

**Weld dressing.**—This is in two stages. A mechanized grinder takes off the gross excess followed by pneumatic hand tools using Tryolite 9 in. discs to finish and polish. Very close control is exercised to stop undercutting below the plate surface.

**Annealing.**—This follows after plate preparation. The plates are annealed to flatten them, homogenize their structure and optimize their electrical properties and the treatment consists of heating a stack of plates in a bell-type furnace to a temperature around 800°C and cooling them again.

Difficulty is encountered, however, due to the size of these plates, which are roughly 10 ft square. If the temperature of one part of a plate is raised or lowered too quickly, it will expand or contract to a greater degree than the rest of the plate, which will cause the plate to warp and buckle and be no longer flat. This meant that much work was necessary to discover the best way to get the heat into and out of a stack of plates as well as to find out the rate at which the temperature could be increased or decreased so as not to cause distortion.

In the early anneals, to discover the thermal pattern during the heat treatment, as many as 26 thermocouples were placed in the stack of plates at various positions and the temperatures recorded.

After the initial anneal which produced warped plates, due to too fast a cycle, an anneal was carried out which took about one month to complete. The furnace was heated and cooled at a very slow rate of about 3°C per hr. This produced flat plates, but as the cycle was much too slow for production, it was necessary to find out the optimum rate at which flat plates could be produced. This work took about twelve months to complete, as each anneal took about one month in the beginning, falling to about two weeks at the end.

Finally, it was discovered which were the hottest and coolest parts of a stack of plates during an anneal. Also from theoretical calculations and experience gained on the early anneals, it was found what the maximum temperature difference could be in a plate at various

temperatures during the cycle, which would not cause distortion.

The furnace system finally developed comprises the main furnace bell elements, hearth elements and a specially developed "throat heating block". These three heat sources are controlled independently to maintain the thermal differences within the safe limits.

Various designs of cooling hood were tried and the following design was used: An insulated cover has an air gap between the inner shell and the insulation layer. By operating flaps at the bottom of the sides of the hood and on the outlets on the top of the hood it is possible to regulate to quite a close degree the rate of flow of air through the gap, and this governs the rate at which the temperature of the stack falls. It has been found possible to reduce the cooling time under this type of cooling hood from five days to three days and so meet production rates.

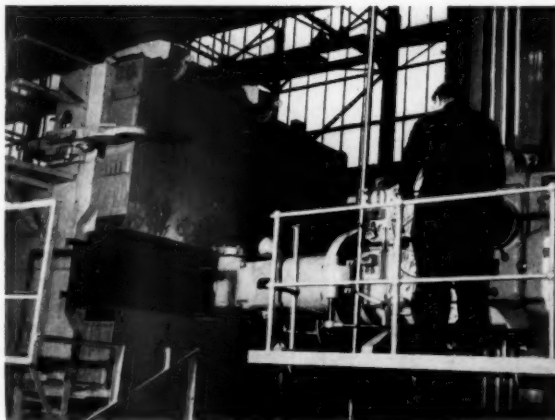
Another problem was the fact that the plates are thicker in the centre than at the edges, causing them to be barrel shaped—a characteristic originating from the rolling mill. To overcome this, the thickness at six positions on a representative number of plates from each cast was measured and compensation allowed for this crowning effect. As the amount varies from cast to cast, tables have had to be made for each amount of crowning varying from 0.002 in. to 0.012 in.

The actual compensation is made by inserting at specific positions within the stack of plates, pieces of cold reduced strip 0.013 in. thick and widths varying from 3 in. to 18 in. These in effect fit into the gaps on the edges of the plates and support them when they become plastic at the higher temperatures.

The annealing process in production is now as follows: The plates are placed on a flat base of 1 in. thick mild steel plate, level to within  $\frac{1}{8}$  in. over the whole area of 100 sq ft. One at a time, the plates are stacked on top of each other together with the compensation strip until a height of 4 ft 3 in. is reached. The full charge when completed weighs approximately 80 tons.

Twelve thermo-couples are then placed in the charge and the throat heating block lifted into position. An inner cover of 17% Cr steel is then placed over the charge, forming a sand seal at the bottom. Into this during the whole annealing process is fed Hi-nitrogen gas, as a protection against oxidation.

The bell furnace, having resistance elements around



The active area of the throat of a 20 ton magnet sector being machined to a tolerance of  $\pm 0.005$  in. and a total tolerance of 0.004 in. in parallelism of the two faces

the four walls and weighing about 20 tons, is then placed over the charge. Together with the base elements and those on the throat heating block the rating is about 500 kW.

The temperature of the charge is then raised slowly at the specified rate and approximately eight days are required to reach the final temperature of about 800°C. During this time the furnace hearth elements and throat blocks are all automatically controlled by programme controllers. At this annealing temperature the plates are roughly 1 in. longer and wider than they were at room temperature.

Cooling then takes place, firstly in the furnace and then under the variable insulation cooling hood. The complete cycle from when the furnace is placed on the charge until the cover is removed takes about 16 days, and in that time about 20,000 units of electricity have been consumed.

When the anneal is completed, each plate must be flat to within  $\frac{5}{16}$  in. over the whole area, otherwise the fabricated sector will not be sufficiently flat.

When annealed the plates develop a permeability as follows:

<i>B in Kilogauss</i>	<i>H in Oersteds</i>
10	abt. $3\frac{1}{2}$
13	" 6
15	" 10
18	" 90

Coercive force developed is 1.5 to 2.0 oersteds.

**Randomization.**—A sector must contain plates from at least five casts, and these must come from at least four different annealing charges, with all three annealing positions (top, middle and bottom) represented, and all positions within the ingots included. The ingot positions follow automatically from the initial randomization in the preparation bay.

From the annealing furnaces the plates are placed on the randomization beds. There are fifteen beds placed in three rows of five and any one cast must go on a set of three beds. The annealing charge is divided into three parts, top, middle, and bottom, with all the tops of the various charges going in one row of five beds, all the middles in another row, and the bottoms in the other.

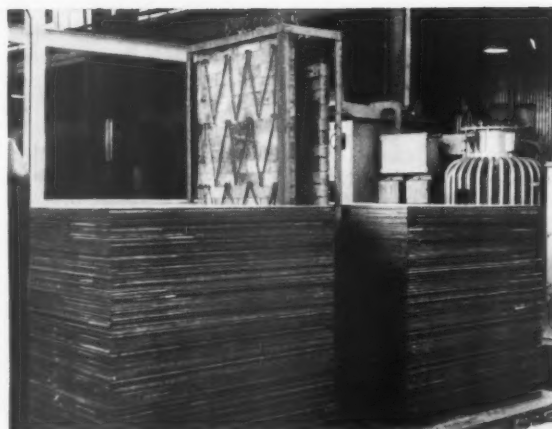
A sector is drawn off the beds, using magnets on an overhead crane, by taking one sheet off each pile in turn going down the rows of five.

**Shearing.**—This operation shears all four sides true and square to each other to a  $\pm\frac{1}{32}$  in. tolerance. This close tolerance is held by careful attention to the stops and shear blades and a strict sequence of shearing as follows:

- 1st, shear to form a straight edge upon one side stopping from the throat area.
- 2nd, shear to form a parallel to the first side, stopping from the 1st cut.
- 3rd, shear to form two right angles, stopping from the throat area again.
- 4th, shear to complete the square, stopping from the 3rd cut.

**Drilling.**—Two Asquith 7 ft o.d. 2-type radial drills are installed and equipped with a nest of locations for a half sector's worth of plates as received from shearing. These locations provide a base for a large drilling jig capable of locating fourteen holes at one setting.

**Defray.**—It is of paramount importance that the surface finish of the plates should be to a very high standard.



A stack of magnet laminations ready for annealing. The plates are on a flat base of 1 in. mild steel plate, level to within  $\frac{1}{16}$  in. over the whole area of 100 sq ft. The plates are stacked with crown compensating strips at the edges until height of 4 ft 3 in. is reached, the full charge weighing 80 tons. The picture also shows one of the specially developed throat heating blocks being dropped into position

A great deal of experimental work in the method and application of equipment was carried out before the present method and procedure was finally laid down.

Using an overhead crane fitted with lifting magnets the plates are placed upon a table which is 30 in. above floor level. Then an electrically operated sanding machine equipped with cloth-based silicon carbide abrasive strip is passed across the surface of the plate in two directions. This machine was originally designed for the surfacing of parquet flooring.

The plate is then transferred to a second table for the deburring of all the holes and edges with Consolidated Pneumatic portable sanders. The plate is then turned over by clip and wire rope and the other side treated the same way.

**D.R.N.S. insulation.**—After a sector has been defrayed and passed by inspection the plates are placed in a steam coil heated soaking pit. After 24 hr the temperature will have risen to approximately 80°C. The plates are taken out of the pit singly by an overhead gantry hoist fitted with magnets. Here again the operation has been made self-contained to ease the load on the overhead cranes. The plates are placed on the extended piston rods of four air cylinders attached to the platform of a recording Avery scale. The weight of each is recorded by the inspection department.

Each sector contains 42 or 43  $\frac{1}{4}$ -in. laminations with or without one  $\frac{1}{8}$ -in. lamination. The weight can be controlled to  $\pm 252$  lb on a total weight of 41,944 lb (18 $\frac{3}{4}$  tons) by varying the number of laminations at this point, i.e.  $\pm\frac{1}{2}\%$  by weight.

After weighing, the plates are lowered by the air cylinders on to a chain conveyor taking them through an automatic spray booth. Here they are sprayed with an insulating coating of D.R.N.S. on the top side. The heat of the plates dries the coating and as they pass out of the booth the D.R.N.S. is hardened by the direct heat from gas jets.

D.R.N.S. is the name given to an insulating coating developed by Sankey Bankfield Works for application to electrical laminations. The coating is patented and its use is exclusive to Sankeys. The special features of this coating are its ability to withstand temperature (up to

800°C) without adverse effect on its insulating properties and the fact that it has no effect on any welding which may be done on steel having this coating. It is applied by spraying and was found by Harwell to be the only insulation of this type to meet their requirements of mechanical strength and electrical insulation. D.R.N.S. is not affected by water or transformer oil.

**Building operations.**—As there is a three-day building cycle, three building beds allow a continuous flow of work to be maintained. The sectors are built in a horizontal position on a bed shaped to suit the final shape of the side of the sector. The shape of the sectors is influenced by the amount of crown in the half plates and the design also calls for added inter-lamination insulation around the throat area.

The first  $\frac{1}{2}$ -in. plate is brought by overhead crane with magnets from the D.R.N.S. stockpile to a building bed. Careful inspection is made of the top and underside of the plate before being covered with insulating paper, narrow crown compensating paper placed along the two edges and varnished, and the additional insulation coated with resin placed around the throat area. The other plates are treated in the same manner and placed one by one on top, finishing with another  $\frac{1}{2}$  in. plate.

As each plate is assembled, an electric resistance reading is taken with an Avo meter between each pair of adjacent plates. Fourteen insulated tie bolts are inserted and tightened to 20 lb-ft with a torque wrench. A separate, shaped grid is positioned on top of the sector and 50 tons of weights distributed equally on the grid.

Thickness checks of the sector are now taken. Thickness within the throat area must be within 12.710 in. and 12.860 in. and along the back and edges it must not exceed 12.500 in. An electric heater is placed within the throat to accelerate the curing of the resin overnight. Side plates are welded in position, 80% of the welding is done at this stage. The weights and grid are removed, the tie bolts are tightened to 100 lb-ft torque and a rapid curing resin is applied to the nuts to lock them in position.

This completes the work on the building bed. The bed is now raised to an upright position by the 25-ton crane and the sector removed to a finish weld station at the extreme end of the building bay. Here the welds that were out of reach on the building bed are completed. The sector is then sprayed with grey paint and stands for seven days before machining.

All subsequent operations are done with the sector vertical.

The coil brackets and lifting lugs are fabricated as a sub-assembly where the rutile iron powder type of manual electrode is used. These electrodes have high metal recovery and fast deposition rates with a low hydrogen content weld metal deposit; here also preforming of the plates is used to off-set welding distortion. Side plate welds are made in two passes, using  $\frac{5}{32}$  in. dia Lincoln Multiweld O.V. electrodes.

The welding of the coil brackets to the magnet sector is carried out after the sector has been finally machined, this weld has to be full penetration, which calls for double V preparation with a 95° included angle.

**Machining.**—The sequence of machining operations carried out on the completely fabricated sector is as follows:

1. Machine the active section of the throat to within 0.020 in. of finished size and to a tolerance of  $\pm 0.005$  in.

2. Rough and finish machine the rear section of the throat to a final tolerance of  $\pm 0.015$  in.

3. Machine one-half of one degree of taper on rear of sector for full height of 10 ft 5 in. to a tolerance of 5 min on angle and  $+0.000$  in.  $-0.020$  in. on thickness.

4. Rough and finish machine two  $2\frac{1}{2}$  in.  $\times$   $1\frac{1}{2}$  in. slots in throat to a tolerance of  $\pm 0.030$  in.

5. Finish machine the active faces of the throat to a tolerance of  $\pm 0.005$  in. and total tolerance of 0.004 in. on parallelism of the two faces relative to one another.

6. Machine four pads on the front of the sector to provide an accurate datum for fixing coil brackets.

The principal points which called for a great amount of development work in establishing techniques are:

A. Each sector must age for at least eight days before any machining is attempted.

B. No burrs between laminations are permitted as they would cause electrical short-circuiting which cannot be tolerated under any circumstances.

C. The minimum amount of clamping is employed, otherwise distortion takes place. Two fixed clamps only are used, all others being adjustable.

D. For the final machining of the active face, the sector is held with scarcely any clamping whatsoever.

The temperature of the sector must be constant throughout its mass within 0.75°C. It is found that any variation greater than this amount will cause movement in the extremity of the throat of up to 0.002 in. per 1°C. An allowance of 0.00025 in. has to be made on the 23.000 in. throat gap dimension for every degree above or below 20°C.

For all operations (except the 2.5 in.  $\times$  1.5 in. slot machining) 14 in. dia face cutters are used, employing tungsten carbide blades.

For rough machining the throat ten negative-rake blades are used, each blade being mounted progressively.

For machining the  $\frac{1}{2}^\circ$  taper on the rear of the sector, the same cutter is used.

For final machining the throat seven positive-rake blades are used and are mounted in line.

In order to ensure freedom from burrs, a freshly ground cutter is used for each sector.

For the slot machining a Clarkson slot mill is used.

**Coil bracket assembly.**—After the sector has been completely machined the coil bracket assemblies are jugged in position and sequence welded in place. The sector must then stand for at least twelve hours to allow the heat of welding to dissipate. It is then given a final coat of paint and taken by crane to the final inspection stand where a complete dimensional check is made. A coat of strippable lacquer is given to the machined surfaces and the sector is completed ready for despatch to A.E.R.E. Harwell by road transport. A completely enclosed holding fixture is provided for this journey.

**Inspection.**—A team of twelve inspectors is employed on this project to ensure that all drawings and specification requirements are met.

Final inspection of the magnet sector is carried out with the sector standing in the vertical position. It is set up with the mean plane of the bottom throat face horizontal within 20 seconds of arc, the back taper faces being not more than 0.030 in. out of vertical, measured over the height of the sector.

A series of twelve readings is taken between the jaws of the throat on the 23.000 in.  $\pm 0.005$  in., after clino-



meter readings for flatness of 0.004 in. have been established. Thermometer readings are taken at back of throat and again at back of the sector, ensuring that the difference between individual readings in any group does not exceed 0.75°C and that the average of all readings in the three groups of three must not be more than 0.75°C.

Complete dimensional checks are carried out together with visual inspection for finish, etc., all findings recorded on final inspection card prior to despatch.

#### Alignment of the magnet at Harwell

The geometric alignment of the magnet of the Proton Synchrotron presents unusual problems in surveying and metrology because of the high standard of accuracy which must be achieved over appreciable distances to maintain the plane of rotation during commencement and completion of bursts of protons. This accuracy can be affected by sinking or tilting of the magnet foundation monolith, or by distortion of the monolith.

In addition it is necessary to locate with accuracy not only the angular and radial position of each sector, but the height and tilt of each relative to any other. Furthermore, once the magnet is set up and the coils and vacuum chambers installed, no realignment of the magnets is contemplated unless there is a significant loss of beam power.

The first precise survey which will be carried out as soon as suitable conditions exist in the magnet room, will commence from construction survey marks. Specially designed instrument stands will enable a precision theodolite or invar tape measuring gear to be set up vertically over the marks by the use of optical plummets. The surveyors will record the measured lengths and angles and extract the data required by the National Physical Laboratory who will, using a DEUCE computer, establish the corrections necessary.

In the first survey the position of the sole plates to which the magnet sectors are bolted will be surveyed.

The method of establishing the true position of each of the primary datum points will be first used to position, in the floor pockets, datum plates with a fiduciary bolt which will then be grouted in position above the construction mark steel plates.

The second survey will determine the true position of the fiduciary bolt but the correction will be applied to position correctly an adjustable datum socket bolted to each datum plate. The adjustable datum sockets have a conical seating to receive a partial sphere with a concentric graticule which will be viewed by an optical plummet. When the adjustable datum socket has been correctly set the sphere will be removed and a cover plate placed in position to protect the datum socket.

By the method described it is anticipated that each primary datum point will be established to within 0.005 in. of its true plan position.

During the foregoing process the relative heights of all the primary datums will be established by placing in the datum socket an invar staff with a spherical end and determining the differences in level by means of a precision "dumpy" level. Forty-four observations will be made on the 24 primary datums and the results communicated to the National Physical Laboratory who will compute on DEUCE the corrected values of the height differences with reference to one point which has been selected as a datum.

After the second survey, further surveys will be carried out as required to check the stability of the monolith at times determined by experience. In these surveys the graticule sphere will be used during the measurement and correction phases.

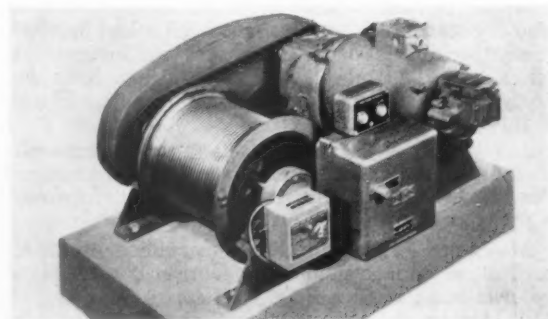
The dimensional stability of the monolith may be affected by shrinkage of the concrete during curing, which is a long process in massive structures; by temperature changes and by deferred creep caused by the stresses imposed by the very substantial loads, due to the weight of the magnets and the weight of the roof and thick earth cover.

To assist in assessing these effects, moisture gauges and thermocouples are being installed at varying depths in the concrete of the monolith, and strain gauges are being installed in the cavities of the monolith. A remote indicating system with 20 resistance thermometers which can be read at one station to an accuracy of 0.2° will be installed. Immediately prior to magnet sector installation, account will be taken of these effects when determining the correction to be applied to the adjustable datums at the primary datum points.

The project team have used on a consultancy basis the services of the National Physical Laboratory and Messrs. Hilger & Watts Limited for determining the surveying processes and techniques. The consulting engineers, Messrs. Merz and McLellan, and the Building Research Station have been consulted on the likely behaviour of the monolith and the latter are installing and will take measurements on the moisture and strain gauges and thermo-couples.

#### Compact Lightweight Winches

Features of a new range of lightweight winches are inexpensiveness and compactness coupled with the fact that out of the whole range—from 175 lb S.W.L., lifting to a height of 84 ft at a speed of 94 fpm, up to 2000 lb S.W.L., lifting 26 ft at 22 fpm—none has greater overall dimensions than 2 ft 6 in. wide × 2 ft 6 in. long × 1 ft. 5 in. high. Each winch is fitted with ball bearings throughout, a 10 in dia rope drum, worm driven top and bottom limits, an enclosed reversing contactor panel with thermal overloads and an electro-magnetic brake. They are all designed for 6:1 or more safety factor. There are 23 varieties of specification and duty in the new range of winches, which are made by Vaughan Lift Engineering Limited, 47-51 Featherstone Street, London EC1.



The new Vaughan winch which is made in 23 types ranging from 175 lb. at 94 fpm to 2000 lb at 22 fpm



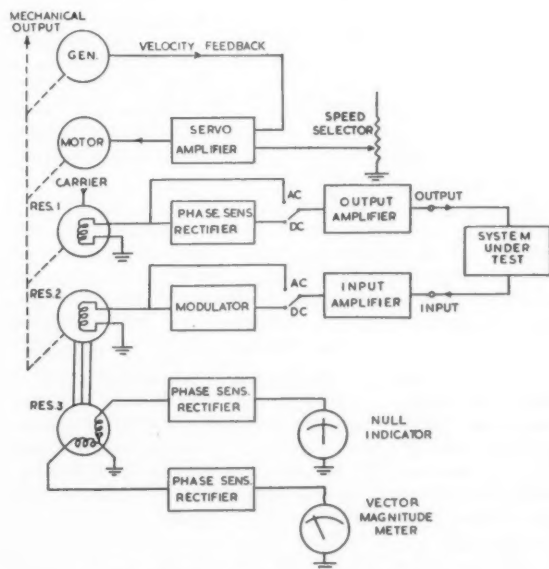
## Analysar Tests Mechanical and Electrical Servo Systems

A universal transfer function analyser which provides stable and accurate means of testing servomechanisms and control gear has been produced by Servo Consultants Limited, 17 Woodfield Road, London, W9. The instrument has an electro-mechanical system which is free from drift, it is insensitive to harmonic distortion (only the fundamental being taken into account), it gives direct indication of phase angle and amplitude, will test a.c. operated servo-systems directly, will investigate the performance of modulators, rectifiers and magnetic amplifiers; and it may be coupled directly to mechanical and hydraulic control systems without the use of actuators.

The principle of the instrument can be explained with reference to the diagram. Two electro-mechanical modulators are driven by a variable speed motor, the speed of which is equal to the test signal frequency. The speed of this motor can be adjusted manually by means of a precision helical potentiometer.

Modulator 1 has a stationary winding which is supplied with a constant amplitude carrier signal. The output winding of this resolver, which is rotating, will therefore produce a modulated carrier signal, which in case of an a.c.-operated servo mechanism is then available directly as a test signal. The carrier supplied to the resolver can be derived either from a built-in 2kc generator or from any other source outside the instrument. In a case of a d.c. servo system this signal is demodulated to obtain the signal at the test frequency. In addition, a mechanical coupling can be introduced between the generator and the system under test.

The output from the system under test can again be either a modulated carrier such as a 400 c/s output from a synchro or a signal at the test frequency. Such a signal is amplified and fed into the Resolver 2, which is



Showing the principle of the Servo transfer function analyser.

rotating in synchronism with the Resolver 1. In a d.c. system the output signal from the system under test is used to modulate the carrier, which is then applied to the Resolver 2. The stator of this resolver has a 3-phase connection to another resolver (Resolver 3) coupled to the angle indicating dial. The angle between the stator and the rotor of this resolver will correspond to the phase difference between the outgoing and the incoming signals to the instrument when the signal from the output winding of this resolver is null. The resolver also carries another winding at right angle to the first one. The output from this winding provides a voltage proportional to the amplitude to the input signal. The magnitude of this vector is indicated by a direct reading meter.



The new Bullocks quick release fluid hose coupling

## New Coupling for Quick Colour Change

A new quick release fluid hose coupling is being manufactured under licence from the Binks Manufacturing Company of America, by Alfred Bullocks & Sons Limited, Long Street, Walsall. The coupling is compact, hard-wearing and its push-and-turn operation is simple, quick and foolproof. The principal advantages are that the coupling enables the operator to make a rapid change of colour, and that the gun can be disconnected for cleaning without the necessity of blowing back or cleaning out fluid lines.

The coupling is in sections: the body assembly attached to the fluid hose, and the stem assembly attached to the fluid connection of the spray gun. The complete coupling costs £1 8s. 0d. plus 20%.

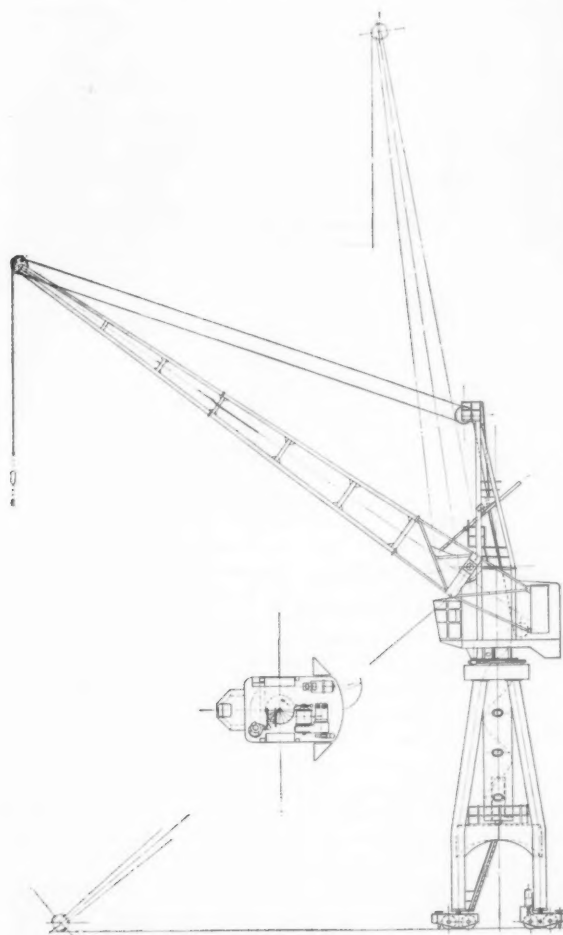
## New Methods and Materials Make a Lighter and More Economical Dockside Crane

**T**HIRTY-FIVE years ago Messrs. Stothert and Pitt Limited, of Bath, introduced the crank-operated level luffing crane and set a pattern for subsequent dock-side crane design. Recently they have originated what is recognizably another mutation in the design of this style of appliance.

It is a cargo crane with clean lines, great saving in weight, simple to operate and to maintain, and adaptable without major modification to the requirements of most users so that, produced in quantity, its price can be kept to a minimum: at the same time the crane is in accordance with British Standards Specifications.

The new crane can lift 5 tons at 80 ft radius or 6 tons at 70 ft, the latter with its shorter jib being no heavier than the former. To change from one type to the other it is only necessary to replace the jib and apex and alter the hoist motor speed. The crane can be adapted for occasional grabbing duties.

The crane is of welded construction with a minimum



Outline drawing of crane showing positions of jib at maximum and minimum radii. The machinery house and cabin are of glass fibre



The new Stothert & Pitt cargo crane has clean lines. It is a welded structure of minimum area

number of members for bolting together at site. Secondary and breaking-up members have been largely avoided by increasing the strength of the main members and arranging them effectively and by adopting modern constructional methods. Members are generally tubular and thus obtain the maximum weight/strength and weight/stiffness ratios, and the surface area subject to atmospheric corrosion is much reduced, and the area that requires painting is about half that of the usual type of crane.

At the upper end of a long pintle tube attached to the underside of the superstructure are three adjustable rollers which rotate inside a segmental roller path bolted to the truck top. The outside of the ring has spur teeth for engagement with the slewing pinion. The lower end of the pintle tube is supported by an oil immersed roller thrust and journal bearing.

The jib is straight, is balanced in all positions and has only one pulley spindle at the head to eliminate unnecessary bending stresses. It is supported by a cross axle integral with the jib which turns in split trunnion bearings bolted to the superstructure. Toplis level luffing is used but the rope angles are such as to eliminate the need for a back pulley at the superstructure apex.

The jib is in three sections bolted together, each being a tubular welded fabrication employing the minimum number of members. It has been designed so that all four

main members are subject to the same maximum load and stress.

Luffing is a single centrally placed hydraulic ram which ensures that, although the driver controls the variable luffing speed, there is always smooth acceleration and deceleration of the jib in all positions whatever the driver should do.

A specially developed, simplified, Ward-Leonard set drives the hoist winch through double helical and spur gearing. It has an exciter, energized by the current in the armature loop circuit, which simultaneously controls the winch motor field and the generator field. This provides the following main advantages:

1. The hoisting and lowering speeds are variable and controlled by the driver.
2. Light loads can be hoisted at three times the speed of the maximum load, and intermediate loads at corresponding speeds, without the use of discriminating relays.
3. A similar characteristic is available when lowering, i.e., as the load is increased the maximum speed is decreased.
4. Automatically controlled lowering by regenerative braking is employed on all lowering notches. An electro-magnetic brake is used only to hold the load in the "off" position and for an emergency.
5. Control is obtained entirely on light current contactors. No contactors are used in the main d.c. circuit.
6. Whatever the load, no heavy current surges are thrown on the supply line.

A d.c. solenoid controlled brake is fitted to the outside of the totally enclosed hoist gear box to which the electric motor is flange mounted.

The hoist barrel is mounted on a dead shaft located by a ball and socket joint at the gearbox end and by a bracket at the opposite end. The drive is transmitted to it by an involute splined coupling capable of tolerating mis-alignment.

The slew motor drives the slew pinion through a fluid coupling and a train of spur gearing. This protects the motor and gear against overload and shock load and ensures a smooth and even drive. The brake is under the permanent control of a Thrustor but its action can be intensified by a pedal-operated hydraulic gear with a limiting device to prevent excessive inertia loading. This gives the driver a sensitive but limited control for arresting the slewing action and at the same time provides an automatic brake which would stop and hold the revolving part of the crane without the driver's intervention. The slew pinion engages with the segmental spur ring bolted to the top of the truck. The ring is integral with the slewing roller path to ensure correct tooth engagement in all positions.

The four two-wheeled bogies are fitted with swivelling as well as rocking gear to minimize cross-racking and enable the crane to negotiate curves. Two of the bogies are fitted with travel gear in which the motor drives through a fluid coupling and worm and spur gear to both wheels. This ensures a smooth and even drive and gives protection against overload and shock. Automatic solenoid controlled brakes are fitted to the powered bogies and a hand-operated safety locking device is fitted to the other bogies. Each bogie has an equalizing jack with a protected screw.

All machinery, except for the travel gear and the luffing ram, is inside the machinery house in self-contained units with flange mounted electric motors. Gears are totally enclosed and oil bath lubricated. Ample space is provided for access and maintenance. The units are designed so that alternative drive means may be provided with little alteration to design or construction; thus a rectifier and d.c. motor may be fitted as an alternative to a Ward-Leonard set, and so may the various a.c. drive systems either with or without change speed gears for the hoist.

The machinery house is constructed of translucent resin-bonded glass fibre which, without windows, gives soft uniform lighting within. A wall crane is provided inside the house capable of lifting any of the machinery units. Jack-knife doors at the back of the house enable any of the units inside to be swung out on the crane. All steel fittings of the house which are exposed to the weather are galvanized.

The driver's cabin is constructed of resin-bonded glass fibre and galvanized steel. "Rubber glazed" safety glass is used throughout and a window is provided in the floor and another in the roof. An adjustable seat is provided for the driver who operates the crane by means of joystick controls.

Access to the driver's cabin is by a step ladder to the pintle platform level, through a sliding door into the pintle tube, up a spiral staircase inside the tube to the machinery house and thence through a door into the driver's cabin. Rung ladders give access through a trap door in the roof of the machinery house to the luffing ram and the apex pulley. No jib ladder is provided as access is obtained by lowering the jib head to the ground.

Ball or roller bearings, fitted with seals, and packed with non-coagulating grease are used for all high and medium speed bearings. These should never need re-greasing, but nipples are fitted to enable greasing to be done, say once per year, if this is desired, the seals being arranged so that excessive internal pressure causes excess grease to escape. All other bearings, except for lever gear within the house, are lined with graphite impregnated Ferobestos.

The crane conforms generally to British Standard 2452:1954, and in some respects the requirements of this specification are exceeded. It may be for 5 tons at 80 ft maximum radius or for 6 tons at 70 ft maximum radius.

## **Heat Dissipating Shaft Seals**

Shaft seals sometimes fail through the effects of frictional heat developed at the contact surfaces of the seals. To overcome this a new series of standard seal seatings has extended surfaces which provide ample area for the transmission of heat to the coolant liquid. One result is that simple seals and sealing arrangements can be used with liquids at much higher temperatures, the only limiting factor now being the temperature limits of the other components of the seal such as synthetic rubber in the lower priced seals, which has a limit of 250° F, and Fluon, which has a limiting temperature of 450° F, in the more expensive units. The new seals have been developed by Crane Packing Limited, Slough, and are the subject of various British, European and U.S.A. patents.

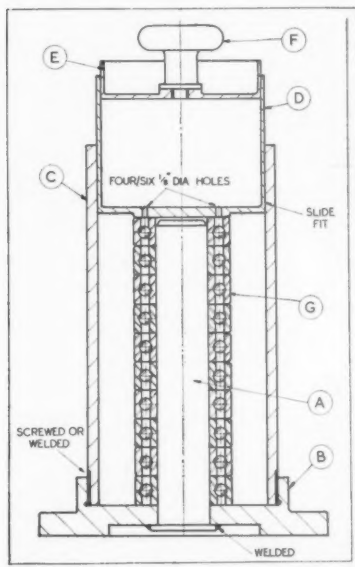
# technique

—devoted to the discussion of practical problems  
Readers are invited to contribute items from  
their own experience in matters relating to  
design, manufacture and maintenance

## Grease Pump for Filling Bearings

The filling of ball races on an assembly line with grease prior to fitting them into a casing can prove a lengthy operation when there are several hundred a week to treat in this manner and the work is messy if carried out by hand. The need is soon felt for a simple device that requires no maintenance and can fill ten or more bearings, according to size, at a single loading of grease.

The grease pump shown in the sketch provided a means of quickly loading ten bearings in about the same time taken to load them in the device. It is necessary to fill the pump after every loading but the grease is easily kept under control.



Filling ball and roller races with grease is easily and quickly accomplished with the aid of this simple pump

Stacking the races is done by dropping them over a central spigot A made some 0.005 in. smaller than the bore of the inner race. This spigot is welded into the base B which has a recess machined underneath it to allow it to lie flat on the workbench and at the same time permit the weld metal to run round the flanged portion.

For sleeve C in which the further sleeve D slides, a scrap piece of steam

pipe was used, being bored to fit the sleeve. The sleeve acts as a clamp and stopper as it presses on the upper race and thereby prevents grease from escaping, and at the same time it makes a location for the piston E which forces the grease into the bearings.

The grease is forced through the holes drilled in the floor of the reservoir and the holes are arranged immediately over the balls and cages. Pushing on the piston causes the grease to pass through each bearing until all are completely filled. A weight stood on the knob F is enough to make the piston sink without physical effort, and the filling of ten bearings is done in about two minutes.

The tube C should be large enough for the bearings to be lifted out easily without having to turn the fixture over—it is better fastened to the bench.

## Cutting Rings for Nuclear Submarine Dreadnought

The hull rings of Britain's first nuclear submarine, the *Dreadnought*, are circular and of various diameters to suit the hull form. They are being

fabricated from four segments each with a double bevel and nose preparation so that they can be welded together. Fabrication of the welded rings is completed by trimming the outside edges by a special circle cutting machine designed and developed at the British Oxygen Company's Edmonton works and delivered to the builders of the submarine, Vickers-Armstrongs (Shipbuilders) Limited, Barrow, within seven weeks of receiving the order. The machine is of the rotary self-propelled type. The carriage, which carries the five-nozzle cutting head, is provided with a radius trammel bar revolving about a circular post.

## Reclaiming Exhaust Valves by Metal Spraying

Before 1955 the U.S. Navy had to spend \$720 on each engine after every tour of duty in replacing worn exhaust valves. Since that time the U.S. Navy has reclaimed more than 50,000 valves at a saving of nearly two million dollars. The change was brought about by the institution of a reclamation programme for spraying a fusion-

A special purpose circle cutting machine in use in the fabrication of transverse hull rings of Britain's first nuclear powered submarine "Dreadnought"

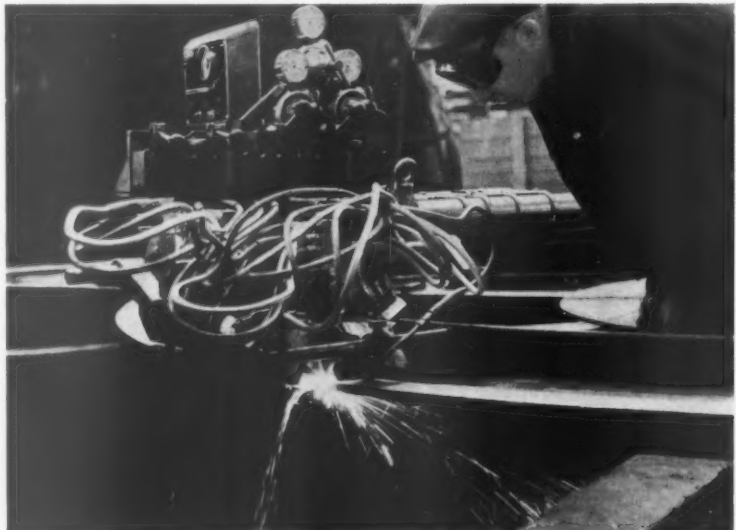






Fig. 1.—Building up a valve stem with sprayed alloy while the stem is rotated



Fig. 2.—Fusion-bonding the spray with oxy-acetylene flame

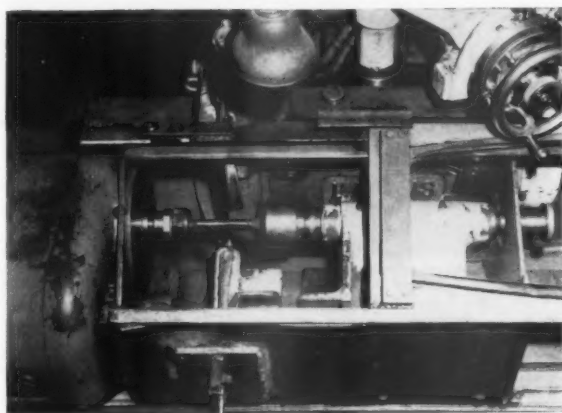
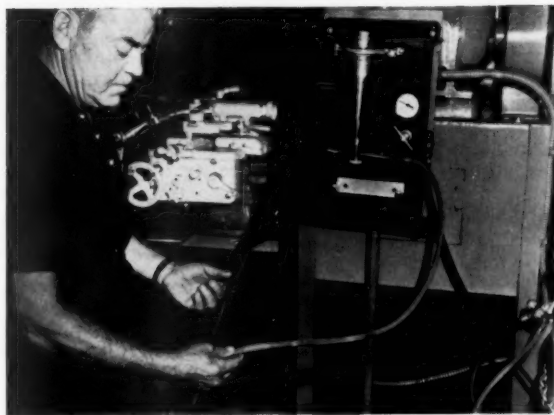


Fig. 3 (left).—Grinding the sprayed stem to finished dimensions

Fig. 4 (right).—Control and feed unit for supplying alloy powder to pistol



Official photographs, U.S. Navy

bonded, non-porous, hard-surface overlay on the stainless steel valve stems. The worn valve stems are first undercut 0.005 to 0.007 in. to allow for the hard surface overlay. The machined surface is then grit blasted with S.A.E. No. 18 mesh angular steel grit to provide a good surface for mechanical bond of alloy during spray operation.

The valve is then mounted in a special fixture in a lathe. While the valve is rotated, alloy is applied in powder form using a spraying unit (Fig. 1). The spray from the pistol is traversed across the surface of the valve stem to obtain the desired build-up on the diameter.

The alloy is a nickel base material containing chromium borides as well as chromium carbides. It provides a protective overlay superior in abrasion resistance to hardened stainless steel. As applied, the alloy is mechanically bonded to the valve stem. The mechanically bonded alloy is next fused to the base metal by applying the flame of an oxy-acetylene torch as the valve rotates

in the lathe (Fig. 2). Rotation of the part insures uniform application of heat and eliminates valve stem distortion during fusing. The fused overlay is then transferred to a centre-type cylindrical grinder (Fig. 3), for grinding to finished dimensions. The grinding operation leaves a hard-surface overlay 0.005 to 0.007 in. thick.

The process is the Wall Colmonoy Corporation's Spraywelding process and the alloy used is the same company's Colmonoy No. 6 in powder form. The unit (Fig. 4) comprises a hopper with a dispenser at the bottom to feed the powder to the pistol at a controlled rate through rubber hose, a control panel, and the Sprayweld pistol.

### Erosion in Pumps

Underground face drainage involves dealing with corrosive and abrasive elements in the water which has to be pumped. To protect the pump a

metal such as Nitalloy, for example, which is widely used in positive displacement type pumps, has a hard surface and good wearing properties but offers poor resistance to corrosive elements and shows signs of corrosion before any wear occurs. Stainless steels are highly resistant to corrosion but wear very quickly when subjected to abrasive elements.

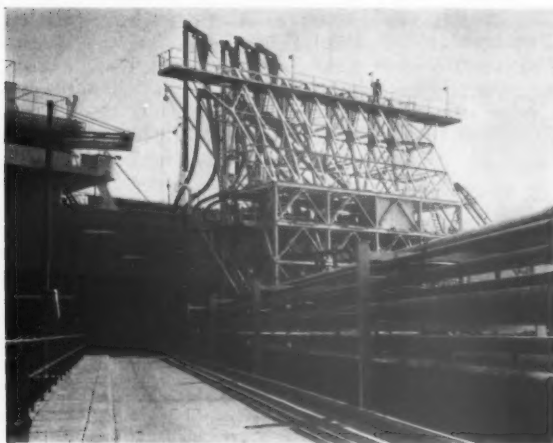
A possible solution to the problem, however, is indicated by research currently being undertaken by Good-year Pumps Limited, 44 Brook Street, London W1. This company, a member of the Holman Group, is experimenting with an 18/8/3 stainless steel rotor, the wearing surface of which is jig welded with a bead of Stellite or Colmonoy (around the periphery of the screw). This combination offers an anti-abrasive surface on the wearing faces which are in contact with a natural rubber bonded stator, while the 'body', which is not subjected to the same wearing conditions, is corrosion resistant.

# Oil Handling and Storage

*The great expansion in the use of oil is being accompanied by building of extensive installations for handling and storage. The new plant at Thames Haven, described below, shows the nature and extent of the mechanical and control equipment employed*

**T**HE largest independent oil storage in Europe is at Thames Haven, in Essex, where London and Thames Haven Oil Wharves Limited have recently installed additional jetties, pipe lines and handling equipment, and where the storage capacity is now 1,750,000 tons and where still more tankage is under construction. The heads of the new jetties are 345 ft long by 40 ft and are connected to the shore by eight approaches carrying access roads and trestles supports for pipe lines. Anticipated pumping speeds of more than 3500 tons per hr involved large diameter pipe lines and large flexible hoses for ship-to-shore connection. The pipe lines have been brought together in the form of headers, one for white oil products and the other for black oils. Each header is rigidly and permanently connected to a Woodfield boom structure.

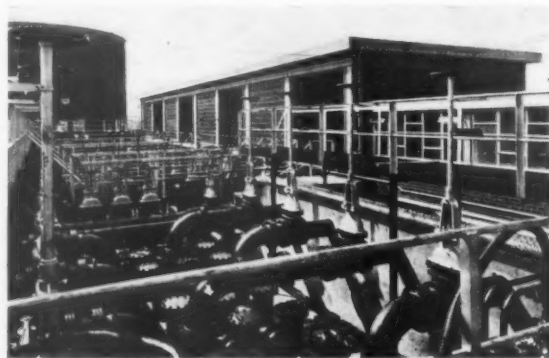
By operating the valves, any black oil product can be handled through the five black oil booms, and similarly for the three white oil booms. The boom structure is so designed that whatever the state of tide, condition or size of ship, the boom arm can be electrically operated to the ship's connection with the minimum of manual aid.



Electrically-operated high capacity hose handling equipment

## Pipe lines

In 1948 the largest pipe line used at Thames Haven, and in most terminal installations, was only 10 in. dia. However, with faster pumping rates and quicker tanker turnrounds, pipe line diameters have been increased to up to 24 in. As a result, pumping rates have more than doubled in the last ten years.



Manifold pits housing the pipe line headers and control valves at electric pump house, designed for complete segregation of products handled

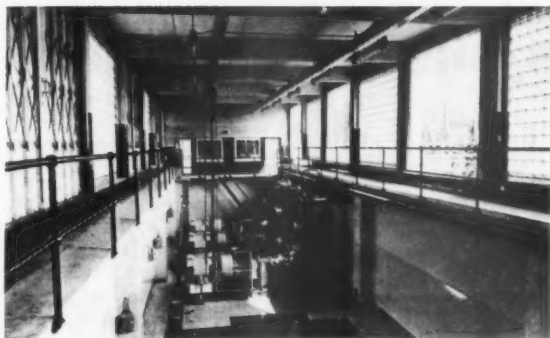
A new elevated pipe line has been erected along the length of the  $1\frac{1}{2}$  mile waterfront, linking together all the jetties. Nearly 10 miles of pipe line varying from 6 in. to 24 in. with an additional 9 miles of inland lines have been installed to complete the system throughout the installation. Pipe lines total more than 150 miles, and are fitted with some 3000 valves.

Aluminium-sheathed lines are steam traced and lagged to maintain the delivery temperatures of the heavier grades of oil, and are heated to increase pumping speeds. Steam is fed in at strategic points and the lagging of the pipe lines carried as far as the tank in some cases. A second stage in the conservation of heat to reduce storage charges has recently been undertaken: namely the complete lagging of the sides and roofs of storage tanks.

## Pump house

The latest pump house to be built under the development programme has a sub-surface pump room to ensure "suction head" (or "flooded suction") to the pumps. The pumping units are two-stage electrically driven centrifugal pumps capable of delivering viscous oil at more than 500 tons per hour while absorbing 250 bhp. Three of these pumps have so far been installed, and three more can be accommodated to give a total output of up to 3000 tons per hour.

The manifold pits housing the pipe line headers and control valves are fairly extensive and have been designed for the complete segregation of all products handled through the pump house. Other features include a sound-proofed control room to house the remote starting controls. The pipe line system connected to this pump house



Interior of pump house designed with a sub-surface pump room to ensure flooded suction to the pumps, which are two-stage electrically-driven, delivering viscous oil at more than 500 tons per hour while absorbing 250 bhp

has been designed for ready expansion. At present, it services 19 tanks with a total of about 120,000 tons.

There are twelve main distribution pump houses in all, each connected to the others as well as to the main distribution points on jetties, road or railcar loading bays, to provide a completely flexible distribution system.

#### Loading stands

The existing roadcar loading stands at Manorway, Thames Haven, can cope with up to 72 cars simultaneously, including such "white" spirits as motor spirits and octanes, rocket fuels, aviation turbine fuels, gas oil and burning oil. A total of 21 grades are dealt with, and delivered to most of the major oil distributors all over the country. Some of the road tankers have as many as six compartments, so that the one vehicle can deliver loads to five or six different customers and thus reduce delivery costs.

The loading stand is supplied through 44 elevated cylinders, each holding about 35 tons or about 10,000 gal. These cylinders are connected to a distribution pump house, and filled daily from the main storage tanks. Delivery to road cars is mainly by gravity feed, although pressure loading is also available.

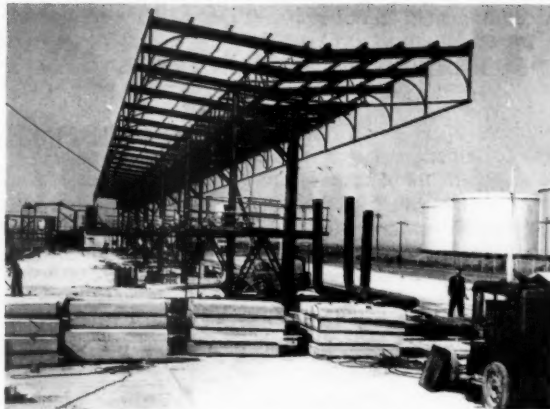
Several subsidiary roadcar loading sites are in operation. More than 420 vehicles per day are dealt with; that is a total throughout of about 4200 tons or nearly 1,250,000 gallons.

#### Loading central

Construction is being completed of a new fully automatic central roadcar loading stand, equipped with the latest devices and designed to cater for the increasing national demand for heavier grades of fuel oil. This new stand will permit 16 vehicles to load simultaneously, and provision has been made for a further 16 loading bays.

All loadings will be carried out automatically. Meters will record the exact loading to an accuracy of 0.1%, and these will be preset from a central control office where the loading information will be automatically recorded. Loading will automatically start upon the operation of a control valve by the driver, and will shut off once the delivery is complete. The entire operation will be controlled from the receiving office, and it will be impossible for a vehicle to load an incorrect grade or quantity.

Deliveries will be made at 400 gpm, enough to load the largest vehicle in under ten minutes. By the time loading is completed, the necessary office papers will



Fully-automatic roadcar loading stands which enable deliveries of oil to be made at 40 gpm, enough to load the largest vehicle in under ten minutes

have been transmitted to the stand by pneumatic tube so that the driver can leave without delay.

Three grades of oil will be dealt with, any grade being available at each loading point. Two of the grades will be heated, the temperature being thermostatically controlled at 140° F. in the main tank. A series of 16 in. steam traced supply pipe lines have been installed to ensure that the required temperature is maintained at the delivery point. The main storage tanks will be lagged to conserve heat.

Constant loading pressure will be maintained, irrespective of the number of vehicles loading a particular grade at one time. This will be achieved by the use of automatic pumps which will cut in and out as demand fluctuates.

#### Boiler house

To meet the demands of the installation, the main boiler house is designed to produce 75,000 lb of steam per hour at 160 psi, and 500° F temperature. Fitted with superheaters and connected to economizers, the boilers are also equipped with pressure jet fuel oil burners.

Instrumentation has been extensively employed in the main boiler house to maintain efficiency at some 73%, one of the highest efficiencies for this type of boiler installation in the country. Feed water is chemically treated to prevent scale formation, and one of the latest innovations is a smoke density recorder and alarm system to control smoke emission from the stack.

Three standby boiler stations are maintained in operating condition, so that a total of some 170,000 lb of steam per hour can be supplied to the installation. The total distribution network of piping for steam is over 22 miles long, most of the steam being used for heating the heavier grades of oil in the storage tanks to facilitate pumping. A limited number of steam-driven pumps are still in use at Thames Haven, but their replacement by electrically driven units is in hand.

#### Worktable for Induction Heating

A new cantilevered worktable for use with induction hardening equipment has been introduced by Delapena & Son Limited, Cheltenham. It is adjustable for height and angle by quickly operated sliding tubes.

# The Deflexion of Asymmetric Beams

By Wm. H. SHEPPARD, B.Sc.(Eng.), A.M.I.E.I.

IN considering the effect of a force on a beam, it is generally realized that the beam will deflect in a direction different from that of the force and various diagrams are used which illustrate this effect. Confusion seems to arise, however, by the non-realization of the fact that there are different figures, each with the same elliptical shape. As a preliminary, this article discusses each one in turn and this is followed by the results of

an investigation into the effects of a force on a beam. For present purposes a symmetric beam under the action of an oblique force is regarded as asymmetric, but with regard to a beam of irregular section it is necessary to determine first the axes, the principal axes, which give deflexion in line with the applied force. A relatively simple method has been evolved and is described below.

## Introduction

Consider a beam of any section and let any element of area  $\delta a$  be referred to two axes at right angles to each other through the centre of area of the section.

Moment of inertia of area ( $I$ ) =  $\sum x^2 \delta a$

Radius of gyration ( $k$ ) is given by  $k^2 = I/A$

about  $x$  axis  $I_y = \sum y^2 \delta a$ ,  $k_y^2 = I_y/A$

about  $y$  axis  $I_x = \sum x^2 \delta a$ ,  $k_x^2 = I_x/A$

Product of inertia  $P_{xy} = \sum xy \delta a$

In line with the previous definition a term will be introduced giving the ratio of the product of inertia to the area:

Product quotient  $p_{xy} = P_{xy}/A$ .

For geometrically similar beams,  $I_x$  and  $I_y$  have maximum and minimum values with respect to the centre-lines or axes and  $p_{xy} = 0$ . In the case of asymmetric beams, the axes to which these conditions apply are the principal axes and others will be referred to as auxiliary axes.

## Ellipse diagrams

(1) Referring to Fig. 1, let  $XX$  and  $YY$  be the principal axes of the section. In the directions of these axes mark off  $k_x$  and  $k_y$  as shown, in the directions to which they refer and construct an ellipse on these axes. Now consider the auxiliary axes  $SS$  and  $TT$ . Draw tangents to the ellipse perpendicular to these axes at  $M$  and  $N$  and let the dotted line shown be the locus of such points for all positions of the axes. Then it may be shown that the radius of gyration in any particular direction is given by the appropriate distances  $OM$  or  $ON$ . It follows

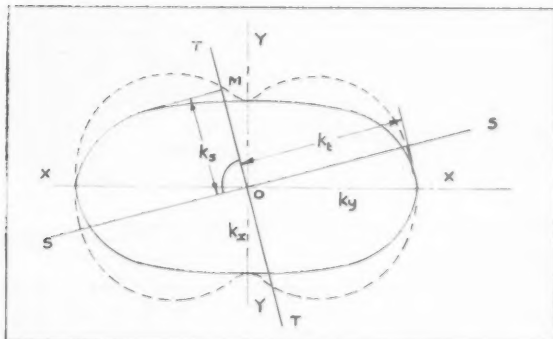


Fig. 1.—"k" ellipse

that for any problem in deflexion, the radius of gyration and thence the moment of inertia may be determined graphically by drawing the appropriate tangent to the ellipse. This method is particularly suitable for determining  $k$  perpendicular to a given axis.

This diagram will be referred to as the " $k$  ellipse".

(2) Referring to Fig. 2, let the axes be taken similarly but in this case let the reciprocals of the radii of gyration be taken along the actual axes to which they refer. It may be shown that any actual radius of the ellipse is proportional to the reciprocal of the corresponding radius

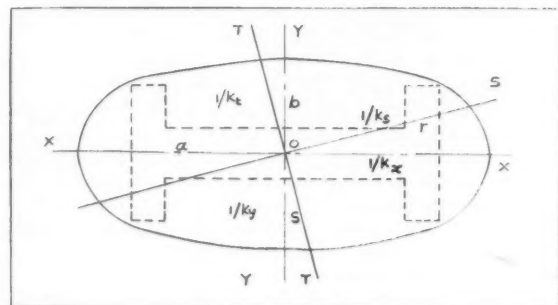


Fig. 2.—"1/k" ellipse

of gyration. This diagram has the advantage that actual dimensions of the ellipse are used. As a check, using a property of the ellipse,  $1/r^2 + 1/s^2 = 1/a^2 + 1/b^2$ .

This diagram will be referred to as the " $1/k$  ellipse" or "reciprocal ellipse".

(3) Referring to Fig. 3, again let the axes be taken as in Fig. 1 but in this case let the semi-axes be taken proportional to the squares of the radii of gyration (or moments of inertia). Auxiliary axes are then drawn as before. The auxiliary circles, radii  $k_x$  and  $k_y$  are drawn and right angled triangles drawn on the auxiliary axes as shown. (Actually it is advantageous to use the method of plotting the ellipse by drawing a series of these connecting triangles). Perpendiculars are then drawn at  $M$  and  $N$  and in this case the value of  $k^2$  in the direction  $OS$  is given by  $OM$ , the product quotient by the perpendicular at  $M$  and similarly for  $OT$ . The locus of  $M$ , giving  $k^2$  in any direction is a figure somewhat similar to the locus obtained in Fig. 1.

This diagram will be referred to as the " $k^2$  ellipse". The " $I$ " ellipse is similar in shape.



$$k_s^2 + k_t^2 = k_x^2 + k_y^2$$

agreeing with the check formula in (2).

### Determination of stresses

Referring to Fig. 4, let this represent the section of a beam, with principal axes  $XX$  and  $YY$ , under the action of a force which produces a moment  $M$  whose trace or axis is a perpendicular through  $O$ . At a point  $P$  the total stress is the sum of the effects of  $M\cos\theta$  and  $M\sin\theta$ .

i.e.  $f = M/A [(v_1 \cos \theta / k_s) - (x_1 \sin \theta / k_t)]$

This formula may be used directly if the co-ordinates of  $P$  are known, but it is usually preferable to determine the neutral axis as follows:

Let  $\theta$  = angle between moment and principal axis  $XX$ .

Let  $\beta$  = angle between principal axis  $YY$  and required neutral axis.

Considering  $P$  on the neutral axis where stress = 0.

$$\tan \beta = (y_1/x_1)^2 = (k_y/k_x)^2 \tan \theta$$

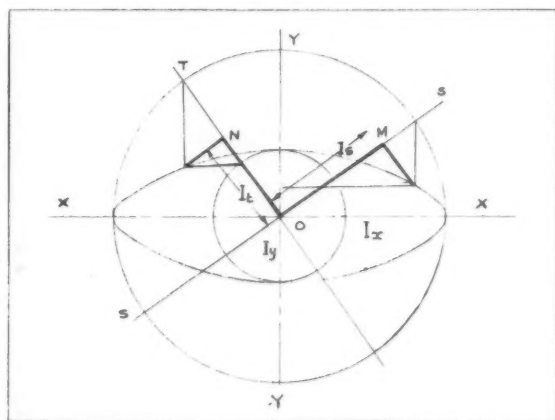


Fig. 3.—“I” or “P” ellipse

giving angle  $\beta$ , and it may be shown that the neutral axis and the plane of  $M$  are conjugate axes to the  $k$ -ellipse. The plane of bending is at right angles to the neutral axis giving angle  $\delta$  to the plane of  $M$  as shown. This angle may be readily calculated as  $\beta - \theta$  but to obtain a formula for  $\delta$ , substitution and a long process of simplification gives

$$\tan \delta = \frac{\frac{1}{2} (k_y^2 - k_x^2) \sin^2 \theta}{k_x^2 \cos^2 \theta - k_y^2 \sin^2 \theta} = \frac{p_{st}}{k^2} \left[ \text{or } \frac{P_{st}}{I_s} \right]$$

It should be noted particularly that  $k$  (or  $I$ ) is in the direction of the axis of the moment and *not* the general direction of bending.

To determine the stress, let  $z$  refer to the neutral axis

$$k_z^2 = k_x^2 \cos^2 \theta' + k_y^2 \sin^2 \theta' \text{ where } \theta' = 90 - \beta$$

$$= k_x^2 \sin^2 \beta + k_y^2 \cos^2 \beta$$

whence modulus of section  $Z = I/z = Ak^2/z$ ,  $z$  being the greatest ordinate. This will give two values  $Z_1$  and  $Z_2$  for  $z_1$  and  $z_2$ , one for each direction. The greatest stresses are  $M/Z_1$  and  $M/Z_2$ , one tensile and the other compressive according to the direction of the applied moment.

It will be realized that the direction of the neutral axis is given on the  $k^2$  ellipse by a straight line through  $O$  forming the hypotenuse of the triangle formed on  $ON$ . This is dealt with more fully in the next section.

### Deflexion of beams

A beam will bend in a direction perpendicular to the neutral axis and the bending moment about this axis is  $M \sin \theta$  where  $\theta$  is the angle thereto of the plane of the applied moment. It follows that the linear deflexion for

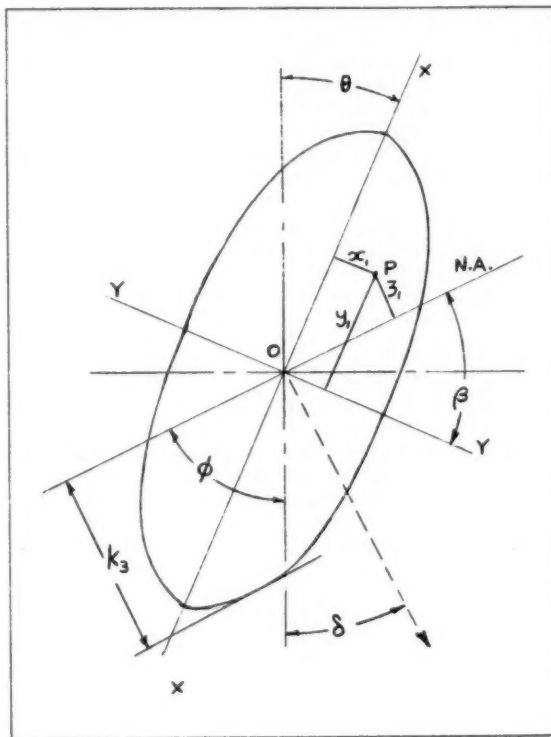


Fig. 4.—Determination of neutral axis

an asymmetric beam is  $(WL^3/QEI)\sin\theta$  where  $Q = 3$  for a cantilever beam and different values for other beams. To determine the locus of a beam when deflected under the action of a force whose direction varies, however, it is convenient in the first instance to adopt a different method of approach. Referring to Fig. 6, consider a beam supported in bearings at the fixed end or ends. (A cantilever will be considered, but the same reasoning applies to other beams.) The two principal deflexions, maximum and minimum, are given by  $WL^3/QEI_x$  and  $WL^3/QEI_y$ , and resolving the applied force in the directions of the principal axes, calculating the deflexions, again resolving vertically and horizontally followed by a long process of simplification it may be shown that the locus is a circle as shown in Fig. 5, two being generated to each revolution. It follows that the angle swept out is  $2\theta$  and in accordance with geometric principles, the principal axes point to the limiting positions forming angles of  $\theta$  and complement as shown. The position of the centre and radius of the circle may be determined by first calculating the maximum and minimum deflexions  $\delta_x$  and  $\delta_y$  whence the depth of centre  $= (\delta_x + \delta_y)/2$  and

radius =  $(\delta_1 - \delta_2)/2$ . (Actually it is only necessary to consider  $1/k^2$ .) Thence the circle may be drawn and deflection plotted for any value of  $\theta$ . To determine the deflection mathematically:

let  $\Delta' = WL^3/QEA$  then  $\Delta_r = k_s^2 \Delta' / k_x^2 k_y^2$  and  $\Delta_H = P_{st} \Delta' / k_x^2 k_y^2$ . Dividing  $\Delta_H$  by  $\Delta_r$  gives  $\tan \delta = P_{st} / k_s^2$  as before.

Also  $\Delta = \sqrt{\Delta_r^2 + \Delta_H^2} = (\Delta' / k_x^2 k_y^2) \sqrt{k_s^4 + P_{st}^2}$   
(or  $(WL^3/QEIA_y) \sqrt{I_s^4 + P_{st}^2}$ ).

The geometric construction of the circle has the great advantage that several deflections may be plotted quickly and accurately. It will also be appreciated that any individual triangle may be solved trigonometrically.

Now consider a beam fixed at its support and the applied force changing direction continuously. The locus of the beam is an hour-glass shape as shown in Fig. 6. To understand the shape it will be appreciated that it is the epicycloid of the radius of the circle in Fig. 5 applied to the centre of the circle rotating about the origin, and this is a hypotrochoid with generating circle one half the diameter of the base circle. The generating point may be at any radius on the generating circle corresponding to different values of  $k_s/k_y$ .

Then: Radius of base circle  $R = \frac{1}{2}(\delta_1 + \delta_2)$  or  $\frac{1}{2}[(1/k_x^2) + (1/k_y^2)]$

Radius of generating circle  $r = \frac{1}{2}(\delta_1 - \delta_2)$  or  $\frac{1}{2}[(1/k_x^2) - (1/k_y^2)]$

Referring to Fig. 3 it will be appreciated that considering the formulae for the deflections  $\Delta_r$  and  $\Delta_H$  given above, since the denominator  $k_x^2 k_y^2$  is constant, the

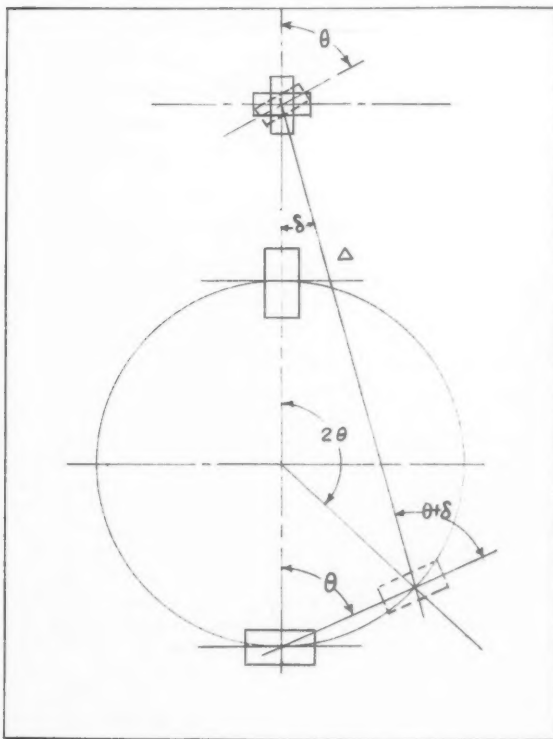


Fig. 5.—Deflection of rotating beam

deflection is proportional to the hypotenuse of the right-angled triangle formed on  $ON$  but this must be applied in a perpendicular direction. The hypotenuse, however, gives the direction of the neutral axis. If the deflections are plotted for a series of positions a curve will be obtained identical to that in Fig. 6. (Actually the same result may be obtained by reversing the right-angle triangle about  $ON$  and plotting the new vertex, but the result will be rotated through 90 degrees.)

#### Determination of principal axes

For an asymmetric section it is necessary to determine first the principal axes. The following are standard formulae:

- (1)  $\tan 2\theta = 2p_{st}/(k_t^2 - k_s^2)$
- (2)  $k_x^2 = \frac{1}{2}\{(k_t^2 + k_s^2) - (k_t^2 - k_s^2) \sec 2\theta\}$  or  $(k_s^2 \cos^2 \theta - k_t^2 \sin^2 \theta)/(\cos^2 \theta - \sin^2 \theta)$   
 $k_y^2 = \frac{1}{2}\{(k_t^2 + k_s^2) + (k_t^2 - k_s^2) \sec 2\theta\}$  or  $(k_s^2 \cos^2 \theta + k_t^2 \sin^2 \theta)/(\cos^2 \theta + \sin^2 \theta)$

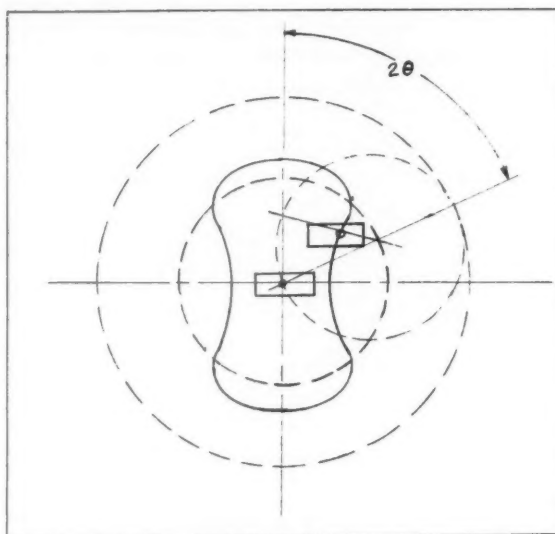


Fig. 6.—Deflection of fixed beam

These formulae presuppose a knowledge of the product quotient  $p$  about a pair of auxiliary axes which in most cases is practically impossible to determine directly. Auxiliary derived areas may be used, conveniently at  $45^\circ$  to the auxiliary axes, but this entails the measurement of several irregular areas. A better method has been evolved and is as follows:

Fig. 7 shows an angle section with leading axes  $SS$  and  $TT$  which are now treated as auxiliary axes. It is first necessary to determine the centre of area  $O$  usually by derived areas in each direction. The area is then considered as a submerged area about a water-line parallel to either  $SS$  or  $TT$  (the longer dimension is preferable) and the centre of pressure  $C_p$  determined. (This is the centre of the first derived floating area.) Next, the centre of volume of revolution  $C_v$  of the area about the water-line is located at the foot of a perpendicular thereto from  $C_p$ . The product quotient of the whole area about the axes  $SS$  and  $TT$  is then given by the area of the rectangle  $O - C_v$ . (Actually, when determining  $C_p$ , since only the lateral position is re-

quired, it is only necessary to draw the derived areas in that direction for the floating area.) This rectangle has the same area with respect to any axis parallel to  $SS$  or  $TT$  and it follows that the locus  $C_v$  is a rectangular hyperbola in both cases.

Then to determine the direction of the principal axes, formula (1) is used, having previously determined the values of  $k_s$  and  $k_t$  by derived areas or other means. It is only necessary to obtain  $a_1$  (or  $a_2$ ), but theoretically  $\tan \theta = (a_1 + a_2)/8r$ . To determine the values of  $k_x$  and  $k_y$  formula (2) may be used in either form. The check formulae given previously should be applied.

#### Similar sections

Beams of geometrically similar shape have connected properties but unfortunately it is not possible to give

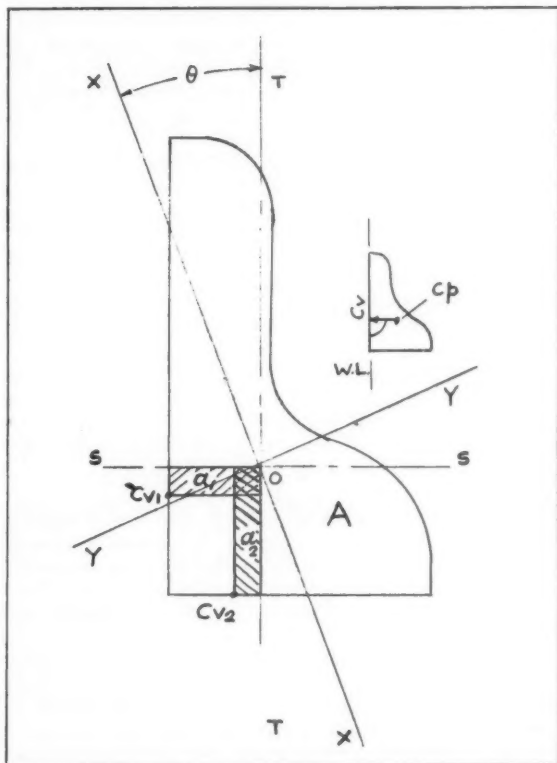


Fig. 7.—Determination of neutral axis

universal values for these. It is usual to give moments of inertia for each size and shape (second moments of area, which should not be confused with second moments of mass for flywheels and the like). It is simpler, however, to give radii of gyration since values for similar beams may be obtained by direct proportion. Alternatively, linear dimensions including  $k$  may be given in terms of a leading dimension and then calculated for a particular beam. Areas may be given in terms of the square of a linear dimension or the product of two at right angles.

For example, let  $H$  = longest edge of angle section in Fig. 7.  $A = aH^2$ ,  $k = k'H$ ,  $z = z'H$ ,  $Z = I/z = Ak^2/z = (ak'^2/z')H^3$ ,  $f = M/Z = Mz'/ak'H^3$ ,  $\theta$  remains constant.

#### Conclusion

Unfortunately, the terms "Moment of Inertia" and "Ellipse of Inertia" are applied indiscriminately to the different ellipses and in any case these should not be confused with "Ellipse of Stress" and "Ellipse of Strain", although certain analogies exist. It is hoped therefore, that the present survey will help to remove misconceptions and enable problems in the deflexion of simple and compound beams to be solved expeditiously.

#### Air Velocity Indicators

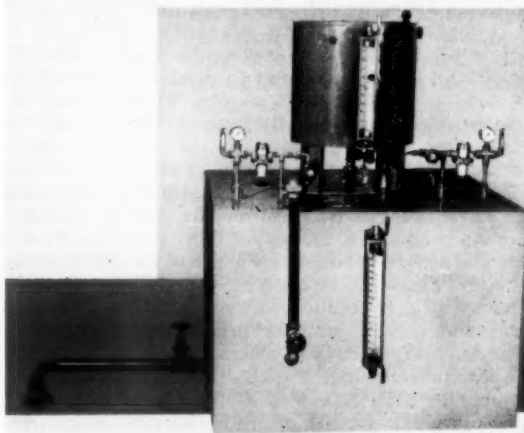
Recent introductions to the British market are two new low-priced air velocity meters: the Florite, a bridled vane anemometer, and the Floret, a small pocket indicator. The Florite is a circular instrument with a die-cast housing, 4 in. dia and 1½ in. deep. The rotating peripheral scale, 8 in. long, gives direct readings in feet per minute or miles per hour. No charts, calculations or other aids are needed. Two scale ranges are available, 0-1000 ft/min and 0-3000 ft/min, the latter scale also bearing graduations in miles per hour. The readings are automatically averaged over an area of 3 in. dia to an accuracy within 2% of full scale reading. A zero adjustment is provided.

In operation, the Florite is simply held to the air flow and the reading taken. The rotor is magnetically damped to level out insignificant variations in velocity and to bring the scale rapidly to rest. A scale lock, released by a spring-loaded trigger, enables readings to be locked on the scale—a useful feature when the instrument is being used in places where the scale cannot be seen. The lock may be permanently released by turning a screw. A detachable handle may be screwed to a long extension rod for reaching particularly inaccessible places. In such cases the scale lock trigger is operated by a cord.

There are two models of the Florite, one for normal use and the other fitted with a special scoop for measuring air flow from square or circular ceiling diffusers or louvres.

The Floret works on the deflecting vane principle, the air entering through a small hole in the base of the moulded plastic case.

The instruments are marketed by Shandon Scientific Company Limited, 6 Cromwell Place, London SW7.



**SOLUBLE OIL MIXER.**—Efficient mixing of soluble cutting oils in the precise proportions required has now been greatly simplified by the 52MT mixing unit developed by Wakefield-Dick Industrial Oils Limited, 67 Grosvenor Street, London W1. Basically it consists of a 250 gal mixing tank surmounted by a 23 gal header tank; both tanks being fitted with graduated scales. In operation, a measured quantity of soluble oil is sprayed over the surface of the water in the mixing tank by air jets. Air also issues from pipes located near the bottom of the mixing tank and the resultant agitation of the fluids ensures complete mixing.

## Cooling Water Intake at Hinkley Point

A concrete caisson weighing 3900 tons was recently towed 2000 ft into the Bristol Channel to form the cooling water intake for the Hinkley Point atomic power station, near Bridgwater, Somerset. Cooling water will flow to the station at the rate of 35 million gallons of water an hour, through two 12-ft dia underwater tunnels which are already more than halfway to the caisson.

The caisson, cylindrically-shaped, 90 ft dia and 60 ft high, is supported on the sea bed on 68-ft long 4-ft dia adjustable steel "spud legs", a technique believed to be unique in power station construction. For the floating, it was filled with a built-in false bottom of timber.

From the specially-constructed dry-dock in which it had been under erection since October last, the caisson was towed first through a dredged channel and then in deeper water through a surveyed, buoyed channel a total distance of about two-thirds of a mile on an almost semicircular route to the dropping zone.

There the spud legs were lowered by a 500-ton hydraulic jacking system mounted on board, and the main flooding valves opened. The whole operation took about eight hours and was under radio control.

Final work was to complete an aerial ropeway which will carry men and materials 2000 ft over the water for tunnelling operations and the driving into the sea bed to form a water-tight cofferdam of a "crinoline" of sheet piles carried round the caisson as it floated. Within the cofferdam, links will be established with the water tunnels reaching the caisson from the shore at the rate of 100 ft a week, the heavy equipment carried aboard the caisson included two excavators.

Civil engineering work has reached an advanced stage at Hinkley Point. The 100 ft main biological shield for one reactor has already been finished, and the second reactor is 80% up.

### Canadian Thorium Plant

Canada's first thorium plant, at Elliot Lake, Ontario, in the Blind River uranium field, was built in six months by Humphreys & Glasgow (Canada) Limited for Rio Tinto Dow Limited, and cost in the neighbourhood of \$1,000,000. It has been built to produce approximately 150 tons of thorium salts a year, which represents a substantial proportion of the current world production.

It is the first installation in the world to recover thorium from the waste liquors produced in uranium milling. Because mining, crushing, grinding and leaching will have been carried out in the normal course of uranium production, the cost of thorium recovery will be low. The process is based on the use of solvent extraction methods. The waste liquor from the uranium processing is passed in acid solution through a series of treatment tanks and mixers, and the precipitated thorium salts separated out, dried and calcined.

Approximately half a pound of thorium can be recovered for each pound of uranium produced. Output from the plant consists of crude thorium concentrates, refined metallurgical grade thorium sulphate and thorium oxide.

The building, entirely of timber, was assembled in prefabricated sections, which allowed the main framework to be erected in a single week. It was designed to withstand extreme temperatures, ranging from  $-30^{\circ}\text{F}$



The caisson for the cooling water intake at Hinkley Point. The structure is seen afloat and being towed into position. The "spud legs" were lowered to attach the structure to the sea bed

to  $+90^{\circ}\text{F}$ , and also to stand the strain of a substantial snow load. A carefully planned lightning conduction system was included. As much of the heavier equipment had to be mounted near the top of the building, many large beams, up to 10 in.  $\times$  16 in. size, were used.

The plant is almost fully automatic, with a single large control panel. There is a total personnel of only 18 employees. A unique feature is the low operating cost of the lighting system. High-brilliance lighting is provided by means of colour-corrected mercury vapour lamps, mixed with fluorescent lamps, both of high acid-resistant design. A special cable was designed by the contractors, also to resist the extreme acid fumes in the building.

Although thorium may well be used in future as material for nuclear fuel, the demand at present is likely to be mainly for non-nuclear uses, of which perhaps the most interesting is its application as a heat-resistant alloy with magnesium in aircraft and rocket engineering.

### Vermiculite for Ion Exchange

The problem of disposal of radio-active waste becomes more acute as more and more nuclear stations are put up and increased fission products, particularly those containing strontium, ruthenium and caesium are produced.

There are a number of ways in which radio-active waste may be disposed of, but, apart from health considerations, there is the need that this should be achieved as cheaply as possible. One method involves the use of ion exchange materials, the chief function of which is to absorb certain elements for which they have an affinity and to give up certain of their own constituent elements in exchange.

There are many materials both natural and synthetic which have these properties in greater or lesser degree, but crude vermiculite, a complex magnesium/iron/aluminium silicate, has been found to fill all the necessary requirements. These can be summarized as follows:

The material must have a high cation exchange capacity: a rapid rate of exchange: good permeability, especially at high pH and sodium values: no breakdown of particles to colloidal dimensions which would pass out of the column thus raising the activity of the effluent: low cost.

At Harwell, the radio-active products are first treated chemically and then filtered through beds of



crude vermiculite of predetermined depth to give the maximum flow rate, consistent with the highest decontamination factor in both upward and downward flow columns. An 18-in. thickness gave a decontamination factor of 600-1000 and the over-all removal of elements

was >97% for zirconium and strontium, 98% rubidium, >98% caesium, and ~99.9% cerium. The Grade 1 crude vermiculite from the Palabora deposit in the North East Transvaal, supplied by Mandoval Limited of London is being used.

## **Merlin: The AEI Reactor**

Britain's first privately owned research reactor, "MERLIN", was made critical recently at the fundamental research laboratory of Associated Electrical Industries Limited at Aldermaston Court in Berkshire. MERLIN was built by the A.E.I.-John Thompson Nuclear Energy Company Limited, who are also building the 275 MW nuclear power station at Berkeley in Gloucestershire.

The research programme for MERLIN covers both the fundamental and applied aspects of reactor research and includes:

1. Study of the effects of radiation on materials.
2. Study of Cerenkov radiation in reactors.
3. The provision of nuclear data and methods of measuring neutron spectra.
4. Activation analysis.
5. Reactor control and safety studies.
6. Production of short-lived radioactive isotopes.

MERLIN will also play its part in the training of nuclear and reactor physicists and engineers.

Originally designed as a 1 MW reactor, MERLIN was redesigned to achieve 5 MW partly because there appeared to be a demand from overseas for a higher powered reactor and partly due to the shortage of test facilities in the United Kingdom. The fuel is uranium 235 and the reactor is water cooled and moderated.

The reactor is unusual in that the core can be moved vertically to four positions. The top position permits the addition or withdrawal of fuel or experimental apparatus from the core. At two lower positions the core is in the plane of sets of experimental facilities. The lowest position is for storage of the core and is so arranged that the possibility of loss of coolant from the tank in this region is negligible.

### **Cooling water**

The reactor and its associated buildings are close to Aldermaston Lake from which the water is used for secondary cooling. The main building contains the reactor and the experimental area, the reactor control room,

the fission product detector and the ventilation plant for the building. Nearer the lake are the primary and secondary coolant pump houses, a laboratory for sub-critical studies of the reactor core, as well as the plant for processing liquid effluent by filtration and ion-exchange.

### **Safety measures**

Twenty fixed radiation monitors are located in the buildings and effluent discharge system. A further four are positioned nearly symmetrically around the reactor, at a distance of several hundred yards, to give warning should there be any undue release of airborne radioactivity. There has been close liaison with the U.K.A.E.A. Safety Branch and several of their suggestions for increasing the safety of the reactor system have been incorporated.

### **Sub-critical facility**

Some of the reactor fuel has been in continuous use since October, 1957, in experiments which have been carried out on various cores of less than the critical size before the fuel was inserted in the main reactor tank. These experiments in the "Sub-critical Facility" have provided much information on the core behaviour as regards critical masses, neutron distributions, the effect of absorbers and of temperature.

### **Reactor staff**

The operational staff of MERLIN will consist of a physicist who will effectively be the reactor manager, supported by three operators, one of whom will be part-time, and one assistant for record-keeping and general duties. This basic staff will be supplemented by reactor supervisors whose duties will be to see that the procedures being followed throughout the reactor system are in accordance with the reactor operating instructions.

Dr. A. J. Salmon is the section leader in charge of the project, and the detailed work in the physics, electrical and mechanical engineering of the reactor has been the responsibility of Dr. K. Firth, Mr. B. Millar and Mr. I. Munro respectively. The Reactor Section, together with the Thermonuclear and Nuclear Physics Sections, constitute the Nuclear

Sciences Group led by Mr. D. R. Chick, who is also responsible for the overall safety from nuclear hazards. Mr. J. N. Barnett, the Laboratory Supervising Engineer, has been responsible for the lay-out of the site with Messrs. Atkins and Partners acting as consultants.

### **Facilities for students**

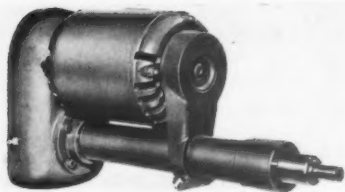
The Universities of Birmingham, London, Oxford, Reading and Southampton have been invited to consider how they might best use the reactor for the instruction of senior undergraduate and post-graduate students, and members of several university departments have already spent several weeks with the reactor team. University departments have also been invited to arrange brief visits to the reactor for final year students in physics, metallurgy and engineering, and longer visits for post-graduate students.

### **A.E.I. work**

A.E.I. spends annually £5½ million on research and development. Quite apart from development work on equipment for nuclear power stations, much nuclear research is being carried out in the A.E.I. research laboratories. These laboratories at Rugby, Trafford Park and Harlow are in addition to the fundamental research laboratory at Aldermaston Court. Much work has been carried out at Rugby on creep and corrosion testing of metals and particularly the compatibility of liquid metals. Similar corrosion testing has been carried out at Trafford Park where a nuclear metals laboratory has recently been opened for the examination of irradiated materials.

### **Nuclear and plasma physics**

At Aldermaston Court two particle accelerators were installed before 1950 and from them much information on the nuclei of the light elements has been obtained. Since 1951 the laboratory has been engaged in research into the behaviour of very high current discharges in gases. (In collaboration with the A.E.R.E., Harwell.) Partial success in stabilizing the gas discharge has been achieved in the aluminium torus known as Sceptre 111. This research is directed towards the eventual use of thermonuclear fusion for power generation.



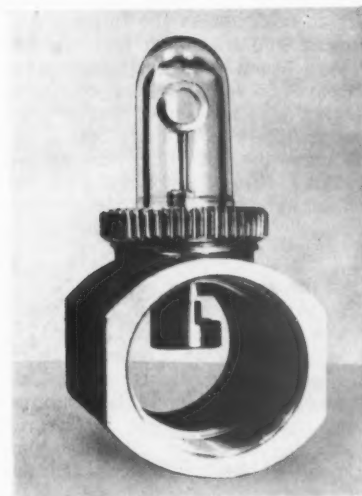
General view of a typical "Auroram"

## Self Contained Thrust Units

Electro-mechanical thrust units which can be operated direct from standard a.c. electrical supply without air compressors or hydraulic motors appear in a new standard range of units put on the market by the Gear Division of George Angus & Co. Limited, under the name of "Auroram". They are in various sizes and can be applied to all the duties customarily assigned to solenoids and hydraulic, pneumatic and vacuum cylinders.

Each unit incorporates an electric motor, totally-enclosed reduction gearing, and a ram which is extended or retracted by means of a screwed shaft and nut arrangement. A special limit switch device is normally fitted to control the stroke, and this can readily be adjusted to give any stroke length within the range of the unit.

Units are available in sizes suitable for thrust loads from 0 to 5,000 lb with maximum stroke lengths to



**LARGER VARIABLE FLOW INDICATORS.**—These instruments which can be adjusted for high or low velocities of flow are now being made by Walker, Crossweller & Company Limited, Cheltenham, in a range to include 1½ in., 1½ in. and 2 in. sizes in addition to ½ in., ¾ in. and 1 in. With Arkon indicators the complete cartridge assembly is interchangeable between the different sizes and the spindle impeller assembly is easily removed and reset for the required flow range



An Auroram used to operate a furnace door. The door is opened and shut by means of a foot-operated switch, and one man can load and unload the furnace single-handed. Previously two men were required

suit users requirements. They are available for foot, flange, or trunnion-mounting.



**ILLUMINATED GRINDER GUARD.**—A guard for grinding wheels which has its own low voltage concealed lighting has been introduced by The Silvaflame Company Limited, 218A Monument Road, Birmingham, 18. The frame is of high duty aluminium and the transparent screen is of Perspex. At the top is a switch controlling two 6 watt bulbs, the latter being covered by a detachable diffuser panel

## Air-cooled Diesel Mobile Compressor

A new air-cooled version of the Jenbach diesel driven mobile air compressor has a capacity of 78 cu ft per min at 100 psi and offers considerable advantages to those users who have to leave their compressors unattended in winter months.

Prime mover and compressor are in one unit, the single-cylinder four-stroke engine transmitting directly

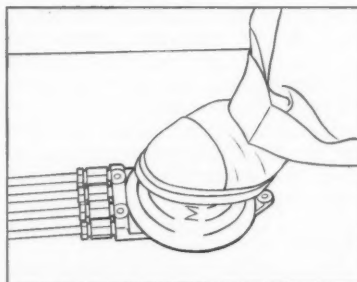


An Auroram has been used to convert an existing heavy swing door to power operation. The door is opened and shut by means of wall-mounted push buttons, but an electronic time-delay switch automatically shuts the door if the user forgets to operate the "close" button. A simple, but very effective, mechanical arrangement ensures that the door cannot trap anyone when closing. The cost of this conversion was only a fraction of the cost of a new power-operated door

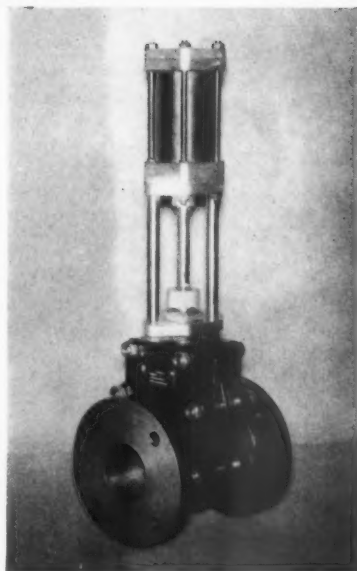
from the crankshaft to the compressor piston by secondary connecting rod linked to the main connecting rod. Engine and compressor cylinders form a 90° angle.

Electric equipment consists of starter motor, dynamo and battery. A speed variation governor, operated by a lever, permits easy changes between 1000 and 1500 rpm.

The engine and compressor are cooled by one blower. There is a special fan for the compressed air cooler. The 3½ cu ft air receiver is mounted on a frame and two ¾ in. air hose connexions are fitted together with pressure gauge, safety valve and automatic condensate water drain valve. Pressure regulation is automatic by a regulator valve in the induction pipe of the compressor operated by a pressure-dependent cut-out governor. The unit is made by Chamberlain Plant Limited, of Crown Works, Southbury Road, Enfield, Middlesex.



**AIR-OPERATED JIG CONTROL VALVE.**—Only 2½ lb effort is required to operate this valve either by the foot as shown or by the knee when bench mounted. The mechanism totally enclosed by the synthetic rubber cover is suitable for air pressures of 20 to 100 psi. Martonair Limited, Parkshot, Richmond, Surrey England

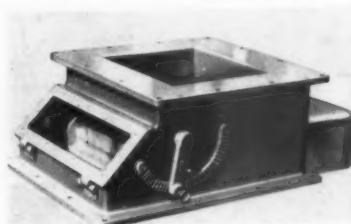


In the new Griffin parallel slide valve the valve discs slide on the ground forces of the outer two of the three parts of which the body is made

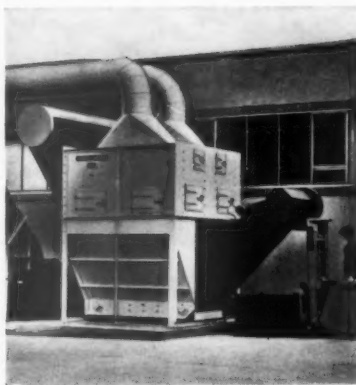
### Parallel Slide Valve

To ensure smooth action and to eliminate any possibility of jamming, the body of the Griffin parallel slide valve is made in three main parts, two identical outer portions and a middle portion with ground faces which form the working faces for the valve disc slides. For non-corrosive fluids and gases at pressures up to 100 psi and temperatures up to 370° F, the body is of fine grain cast iron, valve discs in 'Morganite' metallic carbon with other parts of bronze and stainless steel. A wide variety of alternative materials can be offered for more arduous duties. At present 2, 2½ and 3 in. sizes are available and further sizes will be ready in the near future. The valve can be supplied with pneumatic, hydraulic or electric actuation.

The price of the valves made by Bradshaw & Company (Accrington) Limited, Griffin Works, Accrington, Lancs, vary from about £40 depending on size, type of actuator and the materials of construction.



Barron electro-magnetic vibratory feeder



The Dallow Lambert wet deduster shown above collects fine particles by abrupt changes in direction of the dust-laden gas and thus centrifuges the particles on to wet surfaces where they are held, and by using the kinetic energy of the gas creates an intense spray zone where some of the very fine particles will cling to the water droplets. The collected dust settles to the bottom of the main tank where it can be removed from the collector in sludge or slurry form, automatically or by hand.—Dallow Lambert & Company Limited, Thurmaston, Leicester



**AUTOMATIC SPRAY PAINTING MACHINE.**—This Bullows-Berridge machine has a number of additional features. A friction clutch is fitted to the camshaft drive; spray chamber and inner chamber are quickly detachable; indexing range is increased to give spindles at 3, 6, 8 and 12 in. pitch and variable speed control is standard fitting. Full information and advice may be had from Alfred Bullows & Sons Limited, Long Street, Walsall

### Vibratory Feeder for Pulverizers

A simple electro-magnetic vibratory feeder which works from a 240V 50 cycle supply has been developed by W. S. Barron & Sons Limited, Bristol Road, Gloucester, for feeding dry material into mixers, pulverizing mills, etc. In the recommended style of installation a dog leg spout is used to convey the material into the feeder, thus avoiding excessive weight being applied to the feeder. The material falls vertically on the vibrating tray which is pulsated by the push-pull action of the electro-

magnets and four leaf springs. The intensity of the stroke is affected by a variable amplitude control.

### Indicator for Lubricator Feeds

The provision of visual or audible warning of lubrication failure at the terminal point is purpose of the Manzel Lube-Line Alert, a magnetic switch device which can be used with any make of force feed lubricator. The elements of the Lube-Line Alert, a spring-loaded plunger and a free moving magnet are housed in a stainless steel body and oil or synthetics flowing through a cross port move the plunger and magnet, making (or breaking) the contact of a single-pole, single-throw snap-action switch which is hermetically sealed in glass. After passing the cross port the oil is delivered to the terminal point. If the flow of lubricant is broken, the plunger and magnet return to their original positions thereby making (or breaking) contact through the switch and activating a remote warning device. The standard Lube-Line Alert, made by the British Manzel Oil Pump Company, Durranshill Road, Carlisle, is suitable for applications up to 10,000 psi and explosive proof units are available if desired. The units operate on 0.5 amp d.c. load at 28V.



**TITANIC CHUCKS.**—Some examples from the range of 'Titanic' chucks. High Speed steel screw shank end mills and slot drills made by Samuel Osborn & Company Limited, Clyde Steel Works, Sheffield 3. Advantages of the Titanic milling chuck include great strength of collet with separate screwed collar to ensure true running, elimination of collar dog breakage and improved gripping power

**Skilled hands  
appreciate . . .**



***The Eclipse Range of tools includes:—***

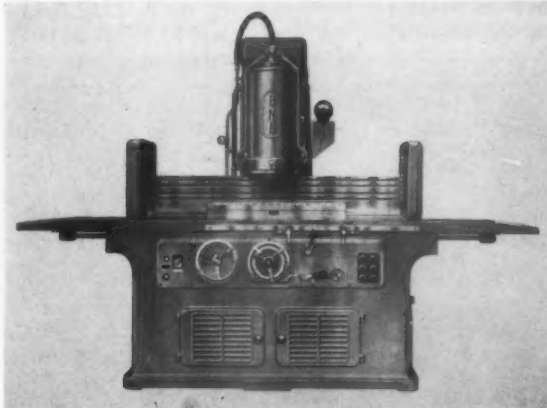
Hack Saw Blades and Frames . . . Sheet Saws . . . Surface Gauges  
Automatic Centre Punches . . . Scribes . . . Tap Wrenches . . . Pin Vices  
Pin Tongs . . . Angle Plates . . . Vee Blocks . . . Tool Bits & Tool Bit Holders  
Saw Sets . . . Coping Saws . . . Junior Saws . . . Piercing Saws . . . Fret Saws  
Jig Saw Blades . . . Trammel Heads . . . Instrument Vices . . . Pad Handles  
Permanent Magnets . . . Magnetic Chucks and Magnetic Tools



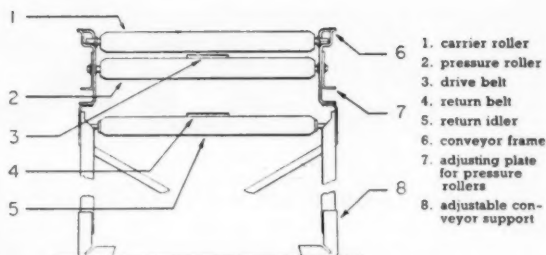


### New Live Roller Conveyor

A new roller conveyor allows sweep-off, accumulation or stoppage of load for inspection, wrapping, weighing labelling etc., without stopping the conveyor. Called the "Rapistan-LR" it is made by Manufacturers Equipment Company Limited, Sutton Road, Hull, and is of the power roller type with provision for adjustment of the rollers to suit operations. The unit idles under no load or light load, so maximising belt life, as also do the smooth surfaced rollers which allow material to be stopped with but little frictional resistance. The roller axles are free-floating in die-formed slots which enables the rollers to rise if anything gets between the drive belt and the carrier. This arrangement also ensures pressure on the belt being in relation to the load and drive required; thus at no load the roller merely idles lightly on the belt. The pressure rollers below the drive belt (see sectional sketch) are spaced so that there is one pressure roller between each two carrier rollers. The pressure rollers are adjustable and all rollers have ball bearings with  $\frac{1}{16}$  in. dia balls and hardened races.

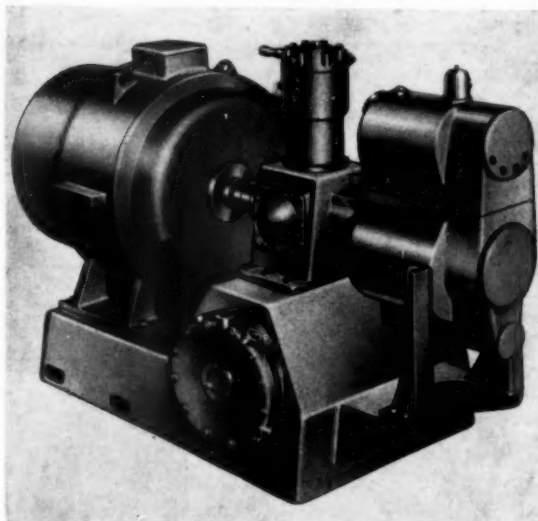


**VERTICAL SPINDLE SURFACE GRINDER.**—The first of a range of production grinders, the VG. 2 vertical spindle surface grinder, is now being marketed by British Northrop Limited, of Blackburn, Lancs. The machine beds are cast in one piece and have a table working surface of 30 in. long  $\times$  12 in. wide with a longitudinal traverse of 45 in. The maximum distance between wheel and table is 12 in. A surface finish of  $6-8\mu$  is obtainable under regular working conditions and the vertical spindle housed in micron precision taper bearings is compensated automatically for wear and for temperature variations. The grinding head has six segments as a normal complement but, in actual practice, three segments only may often be used. There is a double down feed so that with the reciprocating table, feed is applied at each reversal making for a high rate of stock removal coupled with efficient usage of the abrasive.



Sectional arrangement showing how the driving belt has its own rollers which the load carrying rollers float on the top belt level

The carrier rollers (left) of the new Rapistan conveyor are readily lifted out for inspection or cleaning

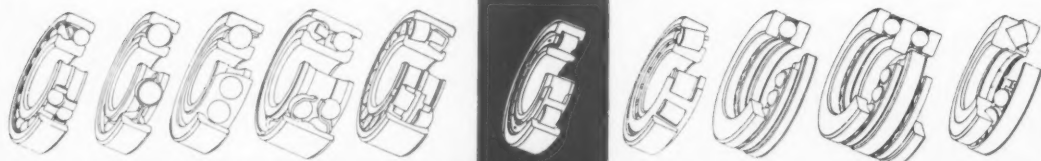


**DIESEL STARTING COMPRESSOR.**—This unit has been expressly designed as a diesel starting air compressor by G. & J. Weir Limited, Glasgow. It is of two-stage arrangement, with a rotary positive-displacement first stage and a single-cylinder reciprocating second stage, an arrangement which gives a small number of piston rings and air valves, and effects a saving of up to 25% in space and 40% in weight compared with a conventional set of similar performance. The multi-purpose cooler is housed in the bedplate, and incorporates an oil-cooler, interstage cooler, after-cooler and final moisture and oil separator sections. It is easily accessible for cleaning in position. Fresh or salt water may be used as the cooling medium. The unit will cover discharge pressures up to 600 psi and capacities up to 150 cfm of free air. The machine may be driven by a.c. or d.c. motor or diesel engine.

### Safety Tool for Jubilee Clips

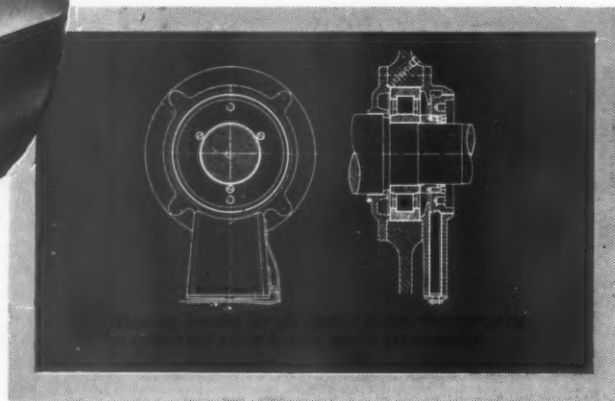
The manufacturers of the "Jubilee" wormdrive hose clip, L. Robinson & Company (Gillingham) Limited, London Chambers, Gillingham, Kent, have produced a special non-slip safety "Jubilee Clipdriver". Apart from the fact that when clips are being applied in awkward situations there is the danger that an ordinary screwdriver may slip, it is often necessary to make the screws very tight to withstand high pressures. The tool, simple in conception and design, is made of bright cadmium plated mild steel and has a spring steel tongue insert to engage in the slot of the screw head. A sleeve extended over the insert fits around the screw head and prevents slipping. The T-bar is set at an angle to the main shaft of the Clipdriver to prevent the application of a large tube or socket spanner. This new tool is designed to fit Jubilee clips only and is made in one head size, as the screw slot in the Jubilee clip range is standard for all sizes. It is, however, made in two lengths, 6 in. to retail at 4/9 and 30 in. to retail at 4/6 each.

*Only* **SKF** *can offer such  
a wide selection of British made bearings*



Illustrated on the left is the **SKF** cylindrical roller bearing, one of the ten variants of the four basic types of rolling bearing manufactured in Great Britain by The Skefko Ball Bearing Co. Ltd. The cylindrical roller bearing has a low coefficient of friction and is therefore suitable for shafts operating at high speeds. Because of its high radial carrying capacity it is extensively used in electric motors, gearboxes and similar applications.

Behind every **SKF** bearing lies unrivalled experience in the design and application of rolling bearings all over the world. This experience is at your disposal from any one of Skefko's twenty Branch Offices, situated at strategic points all over the British Isles.



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THE ONLY BRITISH MANUFACTURER OF ALL FOUR BASIC BEARING TYPES:  
BALL, CYLINDRICAL ROLLER, TAPER ROLLER AND SPHERICAL ROLLER

G170b

**Chemistry for Engineering Students.** By R. Hum. London, 1959; Charles Griffin & Co. Limited. 45/- net (by post 46/9). 857 pp.  $5\frac{1}{2} \times 7\frac{1}{2}$  in.

While written specially to meet the needs of engineers and dealing with chemical substances as a means to an end rather than as a final study in themselves, this is nevertheless a book on chemistry and, for instance, deals fully with chemical theory, which is undoubtedly necessary if one is to do anything useful with chemical knowledge. Besides topics of obvious concern to the engineer—combustion, corrosion and fuel, a large number of elements and compounds of industrial interest are discussed, from iron and steel to germanium, titanium, zirconium and other recent introductions into industry. Ammonia synthesis, plastics, rubber, nuclear energy and radioisotopes all come in for discussion. Glancing through the text we notice how the theoretical aspects are introduced at strategic places—subjects like Le Chatelier's principle, catalysis, the phase rule, osmotic pressure and electronic theory. Altogether the book offers a most useful compilation of chemical knowledge relevant to engineering activity and is deservedly popular, a sufficient indication of this being that the present volume is an up-to-date second edition following upon six impressions of the first.

**Pneumatics for Industry.** By F. X. Kay. London, 1959; The Machinery Publishing Company Limited, 18/6 net (by post 19/3). 160 pp.  $5\frac{1}{2} \times 8\frac{1}{2}$  in.

Pneumatic equipment is used in industry both for instruments and as a means of power transmission. It is the latter with which this book deals, more particularly with pneumatic circuitry as applied in modern production machines. The book opens with descriptions of valves and cylinders and goes on to explain the basic applications and the regulation of speed and thrust, after which instruction is given in circuit building. Succeeding chapters deal with hydro-pneumatics, economy in the use of air, pressure-sensitive devices, pipes, receivers and compressors, and finally various applications are reviewed—operating machine tools of various kinds, a bottle packing machine, a machine for cutting glass, various clamping arrangements and the use of pneumatics in shell moulding.

**Intermediate Engineering Drawing.** By A. C. Parkinson. London, 1959; Sir Isaac Pitman & Sons Limited, 12/6 net (by post 12/8). 247 pp.  $7\frac{1}{4} \times 9\frac{3}{4}$  in.

Most of our readers concerned with the training of the younger generation know this book well. It has gone through 15 printings and now appears in a fifth edition with a number of the illustrations redrawn to bring them in line with B.S. 308:1953. Another change is the adoption of the third-angle system for more of the illustrations. For those who are not familiar with the book it may be mentioned that the first part deals with the conventions used in drawing and with the delineation of the movements of mechanisms, and with methods of projection. The second part deals with the design and drawing of numerous machine elements and includes worked examples with both calculations and drawings.

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## books

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**Mechanics: Part II, Dynamics.** By J. L. Meriam. New York, 1959; John Wiley & Sons Inc. London: Chapman & Hall Limited. 40/- net (by post 41/6). 420 pp.  $5\frac{1}{4} \times 9$  in.

This is the second volume of the work reviewed in our June issue and it is not necessary to repeat our general remarks on the book except perhaps to remind the reader of Professor Meriam's notably practical approach to the presentation of mechanical principles. The first volume dealt with statics. The second is concerned with dynamics and sets out the basic concepts and principles and deals with absolute and relative motion, particle and rigid body motion, work and energy, impulse and momentum, and periodic motion. Appendices present review problems, treatments of vector methods and moments of inertia, and a collection of useful tables. Again of note is the reality of the framework of the discussion—real things like car axles, rockets, gyroscopes, drilling machines, chimney stacks and so on.

**Machine Design Problems.** By Donald J. Myatt, New York, 1959; McGraw-Hill Book Company Inc. London: McGraw-Hill Pub-

lishing Company Limited. 43/- net (by post 50/1). 186 pp.  $8\frac{1}{2} \times 11$  in.

This book contains two parts and a data section. Each page (right-hand—the left-hand pages are blank) sets out a design problem in words and sketches and lists the forces and dimensions which have to be determined. As an exercise, therefore, a design can be worked out and the dimensions in the drawings and lists filled in. The second part contains a few rather more complete machine problems, and the appendix contains the data required for carrying out the exercises. There are no answers or examples to follow so one must just go ahead one's own way in the happy assurance that if one is wrong there is nothing to break. In conjunction with a teacher the book could be very useful. It might also provide quite a lot of interest for a design study group—that is, at an elementary level. Very briefly there are problems in stress analysis and in the design of shafts, springs, fastenings, bearings, spur gear, couplings and clutches, and brakes.

**Crabtree Electrical Handbook.**—Issued by J. A. Crabtree & Co. Limited the "Crabtree Electrical Handbook" is a particularly useful practical aid. The introduction of new wiring materials and methods, the appearance of many new British Standards, changes in regulations, the extensive developments in Crabtree wiring accessories and protective and automatic control gear, all these are reflected in this new edition. A number of sections have been added and the reference tables have been expanded. The book now runs to 424 pages, but it is more than ever a pocket book, the latest edition being lighter and considerably less bulky than its predecessor. This has been done by the use of a new kind of Bible paper and a plastic binding which is both thin and tough. It has been published at the nominal price of 5/- net and may be obtained through booksellers or from the head office of the company at Lincoln Works, Walsall, Staffs.

**Cloakroom and Washing Facilities.**—Suggestions for meeting requirement for adequate cloakroom facilities for industrial workers, with reasonable facilities for drying clothing during bad weather, are made in a new booklet "Cloakroom Accommodation and Washing Facilities in Factories" published by the Ministry of Labour and National Service

## Lighting-1

Good lighting affects productivity in three ways, (1) by directly increasing the speed of working and reducing errors and wastage, (2) by improving overall factory efficiency through better supervision and housekeeping, (3) by providing better working conditions, thus improving labour relations and avoiding frequent changes of workpeople.

It is not possible to judge by the eye alone whether the lighting in any factory is good enough to serve these purposes because the eye has a tremendous range of adaptation (vision of some kind is possible within an illumination range of 1,000,000 to 1) and is hence an unreliable measuring instrument. Severe mental and eye strain or unconscious slackening of working speed may occur under lighting which *appears* to be adequate.

The only reliable way to appraise factory lighting is to conduct a lighting survey using a lightmeter, an inexpensive instrument which measures the actual illumination available. These figures can then be compared with official recommended values for the various tasks.

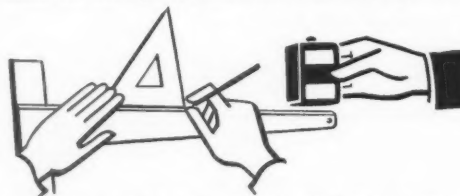
### Lighting Survey

A methodically conducted lighting survey is the first step towards achieving good productive lighting. The average artificial illumination at working height should first be measured. This requires a number of readings at various positions relative to the lighting fittings, particularly beneath and between fittings and by the wall. The average of the readings should then be compared with the illumination values recommended by the Illuminating Engineering Society. The following is a general guide to illumination requirements.



NATURE OF WORK, PROCESS OR MATERIAL	ILLUMINATION LUMENS/SQ.FT.
Rough or routine work. Large detail. Medium to light material of good contrast.	7
As above, but work rather more skilled or critical.	10
Ordinary work usually involving workers' inspection. Medium detail and contrast.	15
Fairly critical work, fairly small detail or poor contrast.	20
Skilled work, small detail or dark material.	30
Fine or critical work, very small detail, very poor contrast or very dark material.	50
Very fine exacting work.	100
Minute work.	200

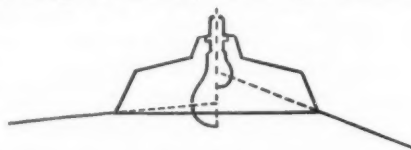
In addition, readings should be taken at selected working points with the lightmeter so placed that it measures the light on the work while the operative



is working. This will indicate whether full use is being made of the light or whether shadow is obscuring part of it.

### Glare

Any direct light on the eye tends to reduce its sensitivity—thus reducing the power to see. Increasing the intensity of the light source may



therefore not improve matters unless care is taken to avoid glare either by correct positioning or by the use of correctly matched reflectors and lamps.

### Walls and Ceilings

Certain surfaces and certain colours absorb light and therefore do not make the best of a light source; others reflect light and, so to speak, feed back on to the work a portion of the lighting which would otherwise be lost. Bright walls, moreover, have a good psychological effect which makes for contented—and therefore productive—operatives.

### Shadows

Unnecessary shadows may seriously slow down work and also cause accidents. Lightmeter readings should always be taken under conditions exactly similar to those obtaining while work is going on. The operative himself may mask his work, an overhead crane or a heavily loaded conveyor belt may periodically obscure a light fitting, or a dust-laden atmosphere may reduce the designed lighting values.



For further information, get in touch with your Electricity Board or write direct to the Electrical Development Association, 2 Savoy Hill, London, W.C.2. Telephone: TEMple Bar 9434.

Excellent reference books are available on electricity and productivity (8/6 each or 9/- post free)—“Lighting in Industry” is an example.

E.D.A. also have available on free loan in the United Kingdom a series of films on the industrial uses of electricity including one on industrial lighting. Ask for a catalogue.



## BOOKS

and now available from H.M. Stationery Office, price 2/6d. net. The Factories Act, 1937 requires the provision and maintenance in all factories of adequate and suitable accommodation for clothing not worn during working hours and specific standards for such accommodation are prescribed in regulations for iron and steel foundries and the jute and pottery industries, and also requires in all factories the provision and maintenance of adequate and suitable facilities for washing. This new illustrated publication seeks to indicate the ways in which the legal requirements in such matters may be met. Guidance is given on such things as location, layout and types of installation, and an attempt has also been made to suggest how to improve on minimum requirements to foster a high standard of cleanliness and health among industrial workers.

**Fish and Engineering.**—A substantial volume of some 600 large pages (8 × 11 in.) entitled "Modern Fishing Gear of the World", shows what a lot of engineering theory and practice now goes into large-scale commercial fishing. One section for instance, "Rational Design: Engineering Theory and Model Testing", goes into the details of the use of model nets as a method of developing trawling gear, the development of mechanical studies of fishing gear, and several aspects of trawl working. The range of industry concerned in meeting the needs of the fisherman is quite large and much scientific and technological work is applied to giving him more efficient and more reliable gear. In addition, he himself has become a technologist with his use of fish locating, detecting and attracting gears, and with the advent of electrical fishing. The book, which is published by "Fishing News", 110 Fleet Street, London EC4, price £5. 5s. 0d., contains nearly half-a-million words and represents some eighteen months editorial work by the Fisheries Division of the Food and Agriculture Organization, Rome. It is a companion volume to "Fishing Boats of the World", issued by F.A.O. in 1953.

**BISRA Report.**—The annual report of BISRA for 1958 is particularly interesting in that it shows how modern ideas are being applied in steelworks research. Radar has found a new use in the study of stockline contour in blast-furnaces,

and radioactive isotopes are being used as tracers in the study of diffusion and mixing in the slag layer, while closed-circuit television helps in measuring accurately the dimensions of hot forging stock, moving rod, etc. Electric arcs in furnaces provide a field for fundamental research, and two cine films, in colour, have been made of arcing in furnaces. The films show clearly the effect of electrode shape on performance. Investigation of the effects of impurities on the magnetic properties of electrical sheet has led to conclusions which may result in the reduction of eddy current as well as hysteresis losses in transformers. P.V.C.-coated steel (BISRA's 'Plasteel' process) has now passed the research and development stages, and BISRA licensees have begun production. Experiments are still being made to improve the methods of applying and curing lacquers. The process of lacquering by electrophoresis is still being developed. Colorimetric, spectrographic and polarographic methods are showing promise in new fields and Siemens X-ray fluorescence analysis equipment is being tried in industrial analysis. A disappearing-filament pyrometer has been developed to measure accurately the last 100° C rise in ingot temperature. This will allow soaking times to be reduced. Trials have shown that a total-radiation pyrometer responds more quickly than a thermocouple to changing furnace conditions. The development of instruments which will make full automation possible is promising, and in computer application many uses are being found for the Ferranti Pegasus computer used by the Operational Research Department.

**Refrigeration Research.**—A report on European refrigeration research and its practical applications has been issued in English by the European Productivity Agency of the Organization for European Economic Co-operation, and is available from H.M. Stationery Office, price 20/- net. It embodies the findings of a mission which visited a number of European countries in 1955 and implements an earlier (1950) recommendation for closer co-operation between research and industry in the subject. It is in two parts, the first describing the general organizations of research and its practical applications in Europe, and the second consisting of twelve reports each dealing with activities in a particular country. It appears from

the report that a number of firms in the European metal working industries conduct pure and applied research on a large scale but that, except in a few of the larger firms, research in the refrigeration industry seems to be done mainly with a view to immediate application, and the resultant influence on design is certainly very direct and effective. Attention is mainly concentrated on the improvement of conventional designs, the analytical study of prototype machines or appliances, and the tracing of faults that may be due to thermal, chemical or mechanical causes.

**American factory supervision.**—Some impressions of supervision in American factories are given by H. A. C. Tracey in a booklet issued by the Institute of Industrial Supervisors, 24 Albert Street, Birmingham 4, and the Birmingham Productivity Association, price 4/-. The features which impressed Mr. Tracey most were not the differences but the similarities in the problems involved and in the activities undertaken to help the supervisor to resolve these problems. The American foreman has more encouragement to join a management club, but the practice of the best British companies does not lag behind the best American practice in this respect. More is being done in America by more people. The idea that foremen and supervisors need training and should play an active part in an organization of their own has had more years in which to become accepted and practised. There is more awareness generally of the opportunities for advancement which active participation in club affairs can ultimately provide.

**Chemical Engineering Course.**—A pamphlet entitled "Scheme for a Full-time Course in Chemical Engineering" has been published by The Institution of Chemical Engineers, 16 Belgrave Square, London SW1. In 1944 the institution published in pamphlet form a "Scheme for a Degree Course in Chemical Engineering," the main purpose of which was to encourage the setting up of university courses leading to a bachelor's degree in chemical engineering. During the fourteen years which have elapsed the course outlined has been used in a number of universities. Copies of the pamphlet may be obtained from the Institution, price 2/- post free.

# BIGGEST AND WIDEST RANGE EVER OF CARBIDE TIPPED DRILLS!

Pioneers in carbide tipped masonry drills, the Rawlplug Company has gone still further ahead with the widest range of percussion, vibration

and rotary drills obtainable anywhere. Whether its for hand or power use, you're bound to find the type and size you want in the Rawlplug range.

## 'DURIUM' TIPPED MASONRY DRILLS

So famous have these amazing drills become that the name DURIUM tends to be used for any drill of its general type. *Don't be misled by this.* DURIUM means the special New Process, almost diamond-hard, carbide tip developed and made only by the Rawlplug Company. No other drill is a genuine Durium. DURIUM Drills give really sensational cutting performances in brick, tile, cement, slate, etc. They are silent in operation and have a quite exceptional long-service capacity for withstanding the abrasive action of masonry that so quickly ruins ordinary drills. Another exclusive feature of Durium Drills is their patented rapid-helix flute, which forces out spoil and prevents clogging. Only a Durium Drill—a genuine Rawlplug Durium—gives such life and service. First resharpening is FREE!

For use in Wheelbrace or slow speed electric drill

17 sizes 5/32" to 1" cutting diameter and 11 long series 1/4" to 1" cutting diameter for up to 16" drilling length.



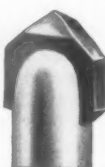
## 'DURIUM' TIPPED HAMMER DRILLS



For percussion drilling in hard materials such as Granite, Blue Bricks, Concrete etc., Durium Hammer Drills have a very much longer life than ordinary percussion drills. They can be used in most electric Hammers and some type of Pneumatic Hammers. 13 sizes from 7/16" nominal drill diameter to 1 1/2".

## 'DURIUM' TIPPED GLASS DRILLS

For use in glass, china, vitrolite, pottery, etc. Can be used in a wheelbrace or slow speed electric drill. 9 sizes from 1/8" to 1/2" cutting diameter.



## 'VIBROTO' HARD TIPPED DRILLS FOR VIBRATORY DRILLING

Vibroto Drills are specially manufactured for use with the Vibroto Drilling Machine, —a high efficiency power tool which allows of two vibratory actions (Light Rapid and Heavy Slow), and also a rotary action for use with standard Durium masonry Drills or ordinary Twist Drills. With their special cutting angle metallic carbide tips, and the high grade steel shanks heat-treated to withstand abrasion, Vibroto Drills put up spectacular performances in the drilling of concrete and other hard materials. Demonstrations can be carried out by Rawlplug Technical Representatives anywhere in the British Isles.

10 sizes 5/32" up to 15/32" cutting diameter.



## 'RAWLCRETE' TUNGSTEN CARBIDE TIPPED (ROTARY) CONCRETE DRILLS

These drill are designed for hole boring in concrete, hard brickwork and tiles with portable rotary action tools. They have from four to six cutting edges (depending on size) and if one should be damaged the remainder will go on cutting. Spoil is automatically carried away through the cored shank and ejected via the slot.

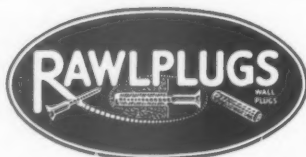
### EXTENSION TYPE DRILLS ANY DEPTH

By adding extension rods to the Extension Type Rawlcrete Drill, any depth of hole can be drilled. 26 sizes 1/8" up to 2" cutting diameter.



## RAWLPLUG FIXING DEVICES AND TOOLS FOR SPEED AND RELIABILITY

**WRITE NOW**  
for illustrated literature  
describing fully these and  
other Rawlplug high  
performance drills and  
power tools.



**THE RAWLPLUG COMPANY LTD.**  
**CROMWELL ROAD, LONDON, S.W.7.**

Telephone: FREMANTLE 8111 (10 LINES)

Telegrams: RAWLPLUG SOUTHKENS LONDON

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**The World's Largest Manufacturers of Fixing Devices.**

# BUSINESS & PROFESSIONAL

## Personal

**Mr. D. D. Teasdale**, chief accountant of Fawcett Preston & Company, a Metal Industries engineering subsidiary, has taken over the additional post of secretary to the company.

**Mr. O. Rendell** has tendered his resignation, on account of ill-health, from the position of works director of H. W. Kearns & Co. Limited. Mr. Rendell, who has served the company for more than fifty-one years, remains a director and his services as a consultant have been retained by the company. **Mr. G. R. J. Hallam** has been appointed a director and also works director. **Mr. C. E. Lowndes** has been appointed works manager.

**Mr. B. L. Scott, B.Sc., A.M.I.E.E.**, has been appointed manager of the Manchester and district branch office of George Ellison Limited in succession to **Mr. A. Ansell**. Mr. Ansell will remain to assist Mr. Scott in a consultative capacity until the end of the year, when he retires after 46 years' service with the company. **Mr. K. B. Oulton** succeeds Mr. Scott as manager of the Newcastle upon Tyne branch office.

**Mr. F. Cartwright** has been appointed project engineer for The Bronx Engineering Co. Limited, Lye. Mr. Cartwright, late of Joshua Bigwood & Sons Limited, is a specialist in all types of metal working machinery.

In order to improve service to customers, all products of the engineering divisions of Geo. Salter & Co. Limited, of West Bromwich, are to be combined under one sales manager, **Mr. G. Rushton**. **Mr. W. A. Whitehouse**, hitherto Midland area manager, has been appointed sales controller (engineering divisions) while a new representative, **Mr. J. M. Hipkins**, will take over the Birmingham, Warwick and Oxford areas. In Scotland and the Border counties, the company has appointed **Mr. Wm. M. Stewart** as technical manager for engineering products.

**Mr. J. L. Blackwood Murray**, managing director of Leyland Motors' South African company, has accepted an invitation to join the board of directors of Leyland Motors Ltd., England, the parent company of the Leyland group of commercial vehicle manufacturers. He is the elder son of Dr. T. Blackwood Murray, who was the first chairman, managing director, and joint founder of the Albion Motor Car Co. in 1900.

**BRITISH INSULATED CALLENDER'S Construction Co.** Limited announce the appointments of **Mr. J. N. Gibson**, Mr.

**J. R. McDonald, B.Sc.(Eng.), A.M.I.E.E.**, and **Mr. D. M. H. Rooney, M.A., A.M.I.E.E.** as executive directors. The appointments are effective from June 1, 1959.

THE following appointments are announced by the Greenham group of companies: **Mr. H. J. Wadeson**, Midlands director of Greenham (Plant Hire) Limited, becomes deputy managing director at the Greenford, Middlesex, headquarters responsible for the commercial development of the company; **Mr. Peter Barrett**, **Mr. Cecil Kent** and **Mr. George Phimister** have been appointed to the board of Greenham Sand and Ballast Co. Limited, Feltham, Middlesex; and **Mr. George Borwell** becomes managing director of Greenham Tool Co. Limited, Isleworth, Middlesex.

**STEELE & COWLISHAW** of Hanley, Stoke-on-Trent, announce that **Mr. R. G. Baines** has been appointed area sales manager for the southern region of England. He will be resident in the London area and will operate from Steele & Cowlshaw's new office at Kingsway House, 103 Kingsway, London, WC2 (Telephone No.: HOLborn 8225), and will be responsible for sales in the paint and ink industries; his colleague **Mr. Vaughan-Bendy** may also be contacted at the Kingsway office, and will deal with other enquiries.

**TEXAS INSTRUMENTS LIMITED**, Dallas Road, Bedford, announce that **Dr. James T. Kendall, M.A.(Cantab), Ph.D.(London), F.Inst.P., A.R.I.C., A.M.I.E.E., F.R.S.E.**, has been appointed general manager marketing and **Dr. John Powell, B.A., D.Phil.**, has been promoted general manager technical in place of Dr. Kendall.

**EXPANDITE LIMITED**, Chase Road, NW10, announce the following changes within the group organisation: Sealanco (St. Helens) Ltd., directors: **Mr. T. Pooley**, chairman (joint managing director, Expandite Limited); **Mr. G. Bussey**, managing director; **Mr. A. Cathcart, F.C.I.S.** (director and secretary, Expandite Limited); **Mr. R. L. Myatt** and **Mr. C. R. Pearce**. Following the transfer of control of Sealanco (St. Helens) Limited to Expandite Limited, **Mr. E. Bussey** and **Mrs. E. M. Bussey** have resigned on retirement.

**Mr. Jack W. Follett** has retired from the board of the Triplex Safety Glass Company Limited after 26 years' service. He became sales director in 1955 in succession to Mr. Kenneth Horne.

**HILGER & WATTS LIMITED** have appointed **Mr. D. G. Heywood, A.Met.**, 21 Kirkstall Road, Sheffield, 11; Tel.: Sheffield 64226, as representative for Yorkshire, Lancashire, Cheshire and North Lincolnshire. Mr.

Heywood's particular province will be the firm's analytical instruments.

**Mr. Peter Allan** has been appointed a director and general manager of F. Perkins (Canada) Limited, Toronto, Canadian subsidiary of the Peterborough diesel engine company, in succession to **Mr. J. S. Bright**, who recently took up an appointment outside the Perkins organization.

**The Viscount Knollys, G.C.M.G., M.B.E., D.F.C.**, chairman of Vickers Limited, has been elected chairman of English Steel Corporation Limited in succession to the late Sir Frederick Pickworth. The ordinary shares of English Steel Corporation Limited are held as to 75% by Vickers Limited and as to 25% by Cammell Laird & Co. Limited.

**Sir Basil R. G. Tangye, Bt., M.I.Mech.E., M.I.Ex.**, of Tangyes Limited, Smethwick, Birmingham, was recently elected chairman of Council. Sir Basil succeeds **Sir Lionel Kearns, C.B.E., B.A.**, chairman and managing director, H. W. Kearns & Co. Limited, Broadheath, Manchester, who had been chairman of Council since 1946. Sir Lionel remains a member of Council and of the executive committee of the Association. **Mr. A. L. Stuchbery, M.I. Mech.E., M.I.Prod.E.**, chief technical engineer of the Metal Box Co. Limited, and **Mr. G. R. Pryor, M.I. Prod.E., F.B.I.M.**, chairman and managing director, Edward Pryor & Son Limited, Sheffield, were elected vice-chairmen of Council.

**Mr. Alan Sanderson, A.M.I.Mech.E., A.M.I.Gas E.**, has been appointed sales manager to Blaw Knox Chemical Engineering Co. Limited.

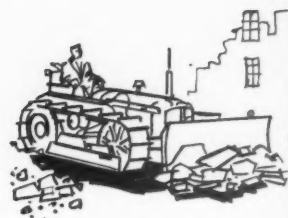
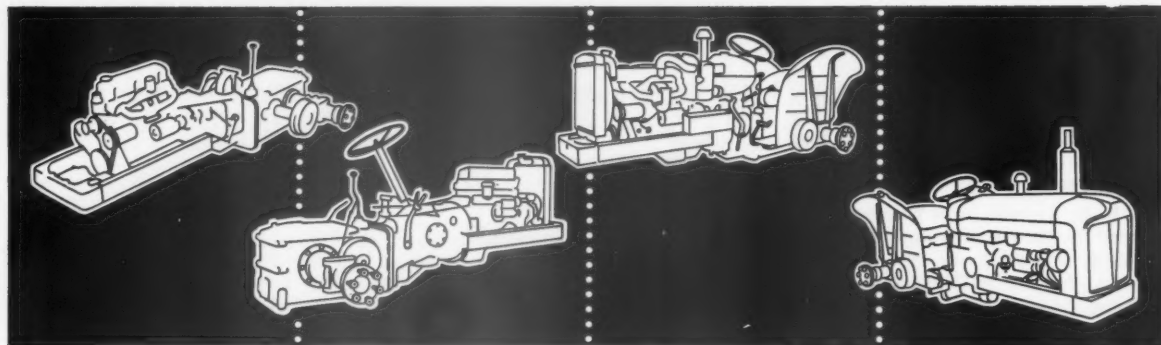
## Obituary

WE regret to record the death of **Mr. W. H. Dodd**, sales engineer of Ottermill Switchgear Limited, at the age of 51. Mr. Dodd served with great distinction during the war years and was mentioned three times in despatches.

WE regret to record the death of **Sir Frederick Pickworth**, chairman of English Steel Corporation. Sir Frederick, who was aged 69, was knighted in 1957. He held directorships in several companies and was a member of Council and Court of Governors of Sheffield University. He was Master Cutler for 1957-8.

WE regret to record the death at the age of 56 of **Mr. W. E. Watson, M.B.E.**, works director of the Cheltenham factory of Smiths Aviation Division. Mr. Watson spent practically the whole of his working life in Smiths and associated companies, starting as an apprentice with Henry

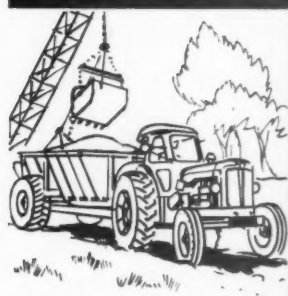




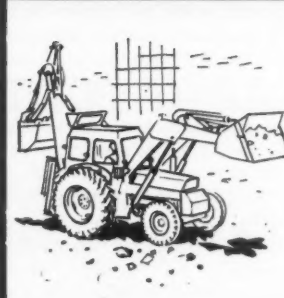
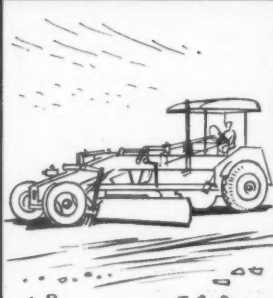
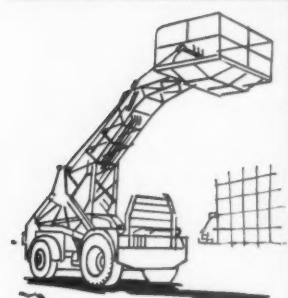
## Buyers looking for better equipment look for **Fordson Power**



...because Fordson Power gives the stamp of reliability, ensures high output at low cost, and because it has the backing of the Ford world-wide service and spares organisation. There are Fordson Industrial Equipment Units in the 30-40 b.h.p. and 40-50 b.h.p. classes, in more than 100 different assemblies. Fit Fordson and you get all the benefits of quality mass production from Ford's famous Dagenham factory, the biggest producer of mobile power units. Fit Fordson, the unit tailor-made to your requirements.



## Wise buyers insist on **Fordson Power**



INDUSTRIAL SALES DEPARTMENT · TRACTOR DIVISION FORD MOTOR COMPANY LIMITED DAGENHAM · ESSEX



## BUSINESS & PROFESSIONAL

Hughes & Son Limited, Barking, Essex (now Kelvin and Hughes Limited) in 1917.

### Addresses

EVERSHED AND VIGNOLES LIMITED, manufacturers of instruments and electronic control equipment, have removed their Scottish area office to 30 Rutland Square, Edinburgh, 1. Telephone number as before, Fountainbridge 3056.

MOORE & WRIGHT (SHEFFIELD) LIMITED have removed to new factory and office premises at Handsworth Road, Sheffield, 13. Telephone numbers 49191/2/3; telegrams "Moorite, Sheffield 13".

CONSEQUENT upon the opening by the Firth Cleveland Group of new London headquarters at Stornaway House, the following changes are announced: To Stornaway House, Cleveland Row, St. James's, London, SW1 (telephone: WHITEhall 2166, Telex 22703), the following divisions of Simmonds Aeroaccessories Limited: export sales, Surform sales, and water separator. The aircraft instruments sales division and industrial instruments sales division of Firth Cleveland Instruments Limited, Landmaster Limited export sales division, and Firth Cleveland Pumps Limited sales division. To Byron House, 7-9 St. James's Street, SW1 (telephone: WHITEhall 5772, Telex 22703), the spire speed nut sales division of Simmonds Aeroaccessories Limited and the sales division of Sheffield Wire Rope Company Limited,

FOLLOWING the recent removal of Baldwin Instrument Company to larger premises at Dartford, the name of the company has now been changed to Baldwin Industrial Controls.

### Film News

*Precision Plus Production.*—A 16 mm sound colour film featuring the Model NB horizontal spindle surface grinding machine of The Churchill Machine Tool Company Limited, Broadheath, Manchester. With a screening time of 22 min the film describes in detail the unique construction of the machine and shows examples of work, including form grinding. On free loan from Sound Services Limited of Wilton Crescent, Merton Park, London, SW19.

### Business Developments

#### Company acquisitions

THE UNITED STEEL COMPANIES LIMITED of Sheffield, have acquired an interest in Concast A.G. of Zurich, and Mr. G. N. F. Wingate, director and general manager of Distington Engineering Company, a subsidiary of United Steel, has joined the Concast board. At the same time The Schloemann Company of Dusseldorf and the Campagne des Forges et Acieries de la Marine et de St. Etienne S.A., Paris, have

also become shareholders in Concast A.G. BRITISH INSULATED CALLENDER'S CABLES Limited are acquiring the whole of the issued capital of Scottish Cables Limited on an exchange of shares basis. Scottish will continue under its own name as a separate entity within the BICC group giving the group a modern factory plant in Scotland. It will also bring into the group a majority holding in Scottish Cables (South Africa) Limited.

TECALEMIT LIMITED have acquired all the shares in Industrial and Domestic Heaters Limited and a majority interest in British Oil Burners Limited.

METAL INDUSTRIES LIMITED is to buy the French hydraulics concern Olaer France Societe Anonyme of Paris.

#### Agents and Distributors—

FLEXIBLE DRIVES (GILMANS) LIMITED, Carlton House, High Street, Smethwick, Staffs, have recently been appointed sole distributing agents for Tyrolit profile grinding wheels and shapes and Tyrolit Secur cutting off discs in the U.K., India, Australia, New Zealand, Eire and all Colonies of the British Commonwealth.

### Contracts and Work in Progress

METROPOLITAN-VICKERS ELECTRICAL Company Limited.—Contract signed between Siderurgia Nacional S.A.R.L., Portugal, and two British firms, Metropolitan-Vickers Electrical Export Limited on behalf of A.E.I., and Babcock and Wilcox Limited covering a complete power station for a steelworks, the first in Portugal, to be built at Seixal, south east of Lisbon.

Order placed with Metropolitan-Vickers South Africa (Pty) Limited by the Electricity Supply Commission of South Africa for two 100,000 kVA auto transformers for Komati power station.

EKCO ELECTRONICS LIMITED.—Order for nine of the recently developed Ekco type nucleonic fluid density gauges for monitoring the Iraq Petroleum Company Limited oil pipelines in the Middle East.

E.M.I. ELECTRONICS LIMITED.—Electronic computer costing over £4m for British European Airways.

ENGLISH ELECTRIC COMPANY LIMITED.—Contract worth £A4½m. to build Australia's first 200,000 kW steam turbo-alternators, negotiated between the English Electric Company of Australia Pty Limited and the Electricity Supply Commission of New South Wales.

HEENAN & FROUDE LIMITED, Worcester.—Supply of a 2,000 bhp Heenan Dynamic dynamometer to the Finnish State Railways. BRITISH INSULATED CALLENDER'S CABLES Limited. British Railways, Potters-Bar.—Greenwood telecommunications contract.

FISHER & LUDLOW LIMITED.—Contract worth \$4m. for bridge decking for the new Prescott-Ogdensburg Bridge linking the New York to Ottawa Highway as part of the St. Lawrence Seaway project. A second contract completed for steel bridge decking for reconstruction work on the Victoria Bridge, Montreal.

THE MAGNETIC EQUIPMENT COMPANY Limited, Lake Works, Portchester, Hants.—Order for Dutch coal mines for 44 400-ton/hr vibratory feeders.

SIEMENS EDISON SWAN LIMITED.—£12,000 special valve order from Murphy Radio Limited.

Progress on the first link in the £88m. Commonwealth Telecommunication cable has reached a further stage with the placing of an order by Canadian Overseas Telecommunications Corporation, Montreal, for terminal equipment at the Canadian end, with Submarine Cables Limited, owned jointly by Siemens Edison Swan Limited and The Telegraph Construction and Maintenance Company Limited.

BRITISH RAILWAYS (Scottish Region).—Contracts placed with James Miller & Partners Limited, Edinburgh, for diesel oil storage and maintenance facilities at Haymarket motive power depot, Edinburgh, and with Herbert Morris Limited, Loughborough, for conveyors, Motherwell long rail welding installation.

TAYLOR WOODROW CONSTRUCTION LIMITED.—Contract valued at over £1m awarded by Central Electricity Generating Board for a hydro-electric project at Cwm Rhedol, near Aberystwyth, Cardiganshire. Consulting engineers, Freeman, Fox & Partners in association with James Williamson and Partners.

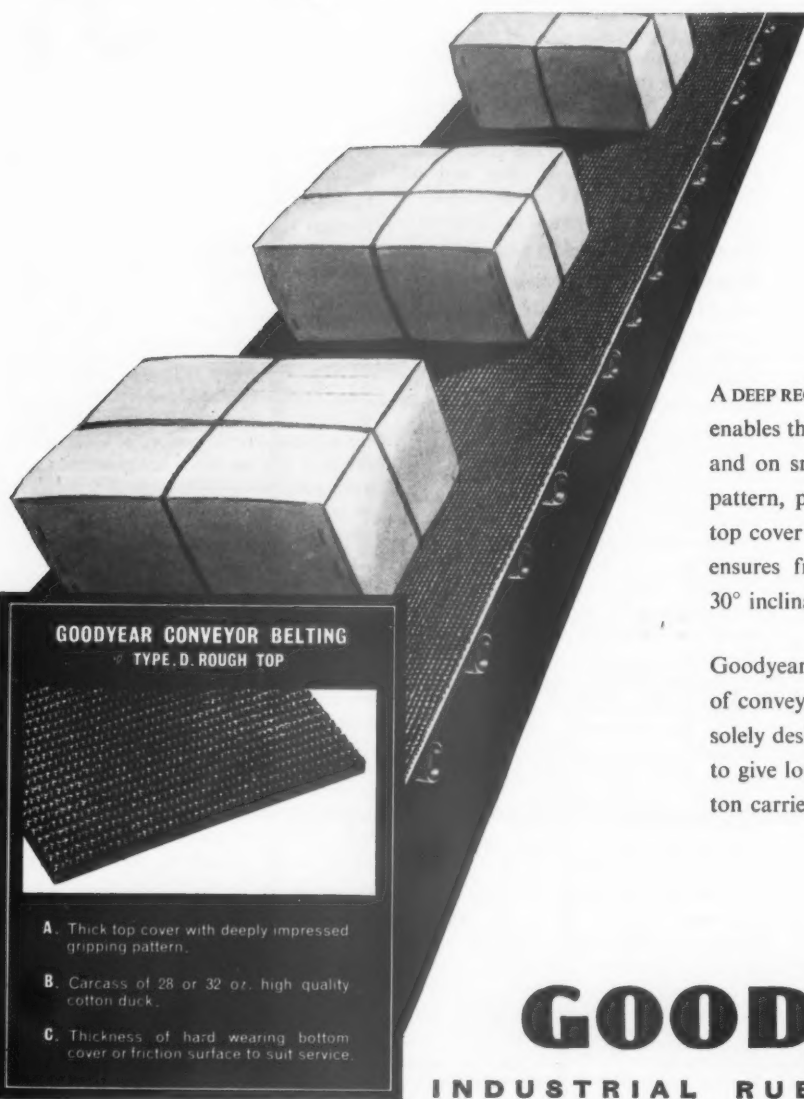
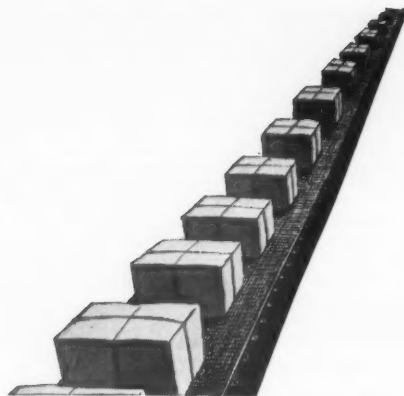
TAYLOR WOODROW (GHANA) LIMITED.—Work recently begun on a brewery at Kumasi, Ashanti, Ghana, to the design of Ingenieursbureau Dwars, Heederik En Verhey, consulting engineers of Amersfoort, Holland. The contract, value over £180,000, was awarded by the United Africa Company Limited; the brewery, to be completed in 12 months, is being built for Heinekens of Rotterdam. Steel-framed Arcon structures supplied by Taylor Woodrow (Building Exports) Limited of Welbeck Street, London, will be used for the buildings and will cover an area of over 100,000 sq. ft.

PRINCE-SMITH & STELLS LIMITED (subsidiary of Stone-Platt Industries Limited).—Order from Warsaw value over £250,000 for the company's New Bradford system of worsted and synthetic spinning machinery.

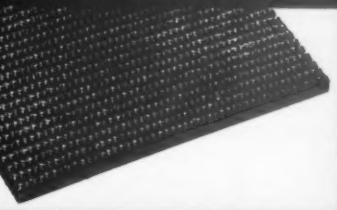
PYE TELECOMMUNICATIONS LIMITED.—Contract value over £21,000 for the supply of radio equipment for installation at the U.K. Atomic Energy Authority's establishments.

# LIFT WITHOUT SLIP

## with Goodyear rough top conveyor belting



**GOODYEAR CONVEYOR BELTING**  
TYPE D. ROUGH TOP



- A. Thick top cover with deeply impressed gripping pattern.
- B. Carcass of 28 or 32 oz. high quality cotton duck.
- C. Thickness of hard wearing bottom cover or friction surface to suit service.

A DEEP REGULAR pattern, exclusive to Goodyear, enables this belting to take a firm grip on sacks and on smooth articles, such as cartons. The pattern, plus a choice between soft and hard top cover to suit the needs of the installation, ensures freedom from slip on slopes up to 30° inclination.

Goodyear Rough Top belting, like all styles of conveyor belting in the Goodyear range, is solely designed for a specific type of duty, and to give long, reliable service at lowest cost per ton carried.

# GOODYEAR

INDUSTRIAL RUBBER PRODUCTS

CONVEYOR BELTING • TRANSMISSION BELTING • HOSE • V-BELTS

### Mining equipment

Revised editions of two of their leaflets on mining equipment are now available from the Westinghouse Brake and Signal Company Limited, 82 York Way, King's Cross, London, N1. The leaflets are Section C.P.28 dealing with mine car traverses and traverser equipment, and Section C.P.2 dealing with mine car decking.

### Permanent magnets

A comprehensive publication by Preformations Limited deals with the development and performance of the Magloy range of permanent magnets. It discusses various magnet materials together with dimensions and tolerances, surfaces and the location of magnetic poles, all of which vary according to specification. The brochure is well illustrated with photographs, tables and performance charts clearly indicating the variety of applications for Magloy magnets, which include radar, television, electronic, aircraft, and automotive equipment. Copies are available from Preformations Limited, Cheney Manor, Swindon, Wilts.

### Servo Power Cylinders

The Mark-4 air operated power cylinder for servo control of plant-regulator position is the subject of Publication 332 available from George Kent Limited, Luton, Bedfordshire. The cylinder is made in nine sizes and for end or trunnion mounting.

### Labels and Containers

Two new products are described in leaflets issued by Precision Components (Barnet) Limited, 13 Byng Road, Barnet, Herts. They are "Presson" a new range of self-adhesive transparent label holders,  $\frac{1}{2}$  in. and 1 in. deep, which will stick to any clean, flat surface; and a new range of polythene containers ranging from 22 x 21 x 6 in. rectangular trays up to 50 gal barrels, with or without lids or pouring lips. They are chemically resistant and withstand rough usage.

### Thread Rolling Dies

The thread rolling process is used for a good many other purposes besides making screw threads, it is also used for gear teeth, worms, and grooves in great variety.

The dies now available for the whole range of this work are numerous and their application has given rise to a specialized body of information. The Small Part Division of W. H. A. Robertson & Co. Limited has done a useful service in collecting this information and much practical data into what is virtually a monograph, in the form of the latest of their "Guides". Equipment, from many countries is detailed, to provide initial information and for basic comparison. The booklet is available from the company's office at Lynton works, Bedford.

### Cupola Collectors

The Holmes-Schneible SW cupola collector has been introduced to combat the problem of atmospheric pollution from cupolas. The equipment is fitted to the top of the cupola and contains a combustion chamber in which carbonaceous solids are converted to gaseous products. The gases pass through an annular passage where they are washed with a water curtain, the washings going to a dewatering tank. An illustrated folder giving full technical details is obtainable from W. C. Holmes & Co. Limited, P.O. Box B7, Turnbridge, Huddersfield.

## Trade Literature

### Cincinnati Shears

The Cincinnati Shaper Company Limited, Peel Park Place, East Kilbride, Glasgow, Scotland, have published a 12-page catalogue in three colours covering their range of British built Cincinnati guillotine shears. These American designed guillotine shears, which are noted for their accurate shearing are of all steel interlocked construction and incorporate, among other features, powerful hydraulic hold-downs, non-float inclined ram, front controlled power operated back gauge, strongly made multiple jaw clutch and automatic pressure lubrication. The range of British built guillotine shears covers lengths from 4 ft up to 18 ft with capacities from 12 gauge sheet up to  $\frac{1}{2}$  in. plate.

### Aabacas Cranes and Hoists

A new hoist catalogue now available from Aabacas Engineering Company Limited, Birkenhead, shows a great variety of cranes and hoists. Of the overhead travelling type there are single girder cranes, underhung cranes, double girder cranes and box lattice cranes. Examples of special types illustrated are wall travelling cranes, jib cranes, telfers, goliaths and semi-goliaths. The Aabacas hoist is made in a full range of types and sizes: it is of compact design with the motor partly inside the rope drum.

### Morganite Unit Type Seals

A new catalogue from The Morgan Crucible Company Limited, Battersea Church Road, London, SW11, gives full technical details required for the application of Morganite unit seals. The different types are illustrated and the dimensions tabulated in both inches and millimeters. In addition to the excellent design of the seal, the material (fabricated morganite carbon) of which it is made has special advantages, particularly its chemical resistance and its ability to operate under severe conditions. There are two types, a unit seal and a positive drive unit seal. They are both suitable for the envelope sizes recommended in B.S. 2896 and B.S. 2993.

### Morganite Carbon Brushes

Comprehensive data on morganite carbon brushes for electrical machinery are given in a new catalogue available from The Morgan Crucible Company Limited, Battersea Church Road, London SW11. The physical properties of the different classes and grades are tabulated and clearly printed graphs are included of the electrical and frictional characteristics. Useful guidance is given on brush construction and shape and there are particulars also of connectors, protective tops, flexibles and terminals, and hints are given on brush mounting. The catalogue is a bright and well printed production.

### Birlec-Morgan Electric Die-casting Furnace

The Birlec-Morgan electric die-casting furnace, type E.D.F. mk. II, combines a high standard of metallurgical and temperature control with ideal working conditions for diecasters. It is fully described and illustrated in a new folder available from The Morgan Crucible Company Limited, Battersea Church Road, London, SW11.

### Morgan Oil-fired Basin Tilting Furnace

Illustrated particulars of the new Morgan tilting furnace are given in a folder issued by The Morgan Crucible Company Limited, Battersea Church Road, London, SW11. Specially designed for rapid bulk melting both for die-casters and general non-ferrous foundries the furnace is of the oil-fired basin type and gives a high melting rate with low fuel cost. Control is simple with easy lip-axis pouring. The design of the furnace ensures low metal loss and low crucible cost.

### Royce Electric Box Type Furnaces

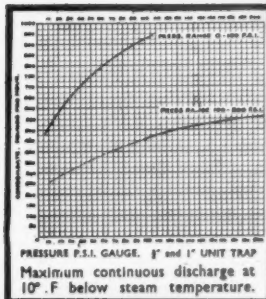
Made in two standard ranges for temperatures up to 1000°C, and 1250°C, Royce electric box type furnaces are complete units which do not require special foundations. Supply is normally 3-phase commercial to low-tension, but the makers can arrange for single or two-phase if required. A floor mounting panel houses the automatic temperature control instrument and a fusible type excess temperature cut-out is provided. The transformer is of medium voltage to B.S. 171. The makers, Royce Electric Furnaces Limited, Sir Richard's Bridge, Walton-on-Thames, Surrey, have issued a new catalogue giving full particulars and illustrations.

### Precision Lathes

A new folder from Oldfield & Schofield Company Limited, Halifax, describes the company's Model ND precision V-bed 21 in. and 25 in. swing lathes. These are all-gearhead stock machines with quick change gearbox and ample spindles speeds and sliding and surfacing feeds. Both machines admit 5 ft 3 in. between centres.

"The Lancaster"  
ESTD 1890

# UNIT STEAM TRAP



... A NEW  
TRAP BY AN  
OLD MAKER

**IT'S SMALL  
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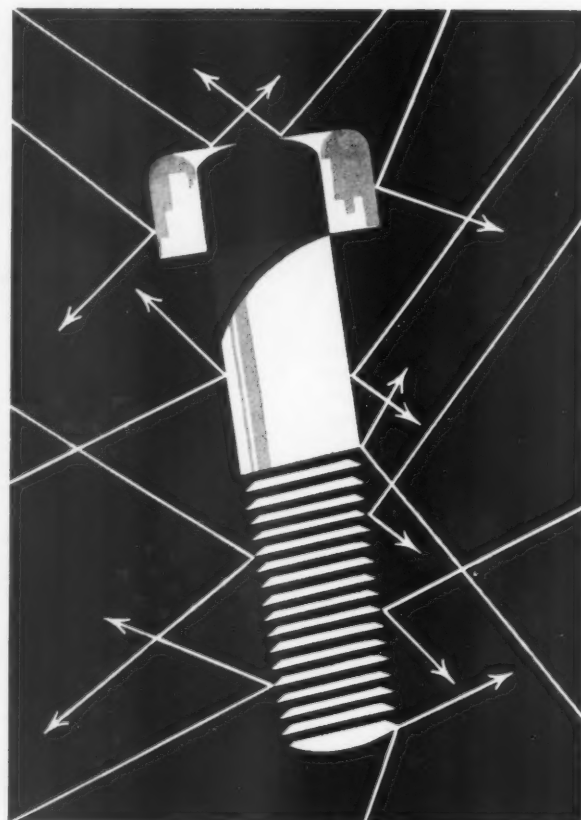
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**Blaydon (Co. Durham).** Shell Mex and B.P. Ltd. The architects for the proposed erection of offices are W. & T. R. Milburn, 18 Fawcett Street, Sunderland.

**Brandon (Co. Durham).** C. W. Gilbey, ice cream manufacturer, 23 Station Road, Ushaw Moor, proposes ice cream factory, garages, and houses at Lowland Road, Brandon.

**Chester-le-Street.** The National Coal Board are to erect workshops at Handen Hold Colliery. The Board's architects dept. is at 24 The Side, Newcastle upon Tyne.

**Cumberland.** West Cumberland Industrial Development Co. Limited, 30 Roper Street, Whitehaven, are to carry out factory extensions on behalf of Cumberland Childwear Limited, Maryport; Cumberland Curled Hair Manufacturing Co. Limited, Hensingham; and Marchon Products Limited, Whitehaven.

**Darlington.** Tees-side Farmers Limited. The contractors for the erection of a warehouse at Piercebridge are D. M. Willoughby, Malpas Road, Northallerton.

**Gateshead.** Sigmund Pumps Limited. The scheme for factory extensions on Team Valley trading estate is being discussed with the planning authorities. The architects are G. H. Gray and Partner, 8 Portland Terrace, Newcastle upon Tyne.

**Hartlepool.** Richardson, Westgarth and Co. Limited. The contractors for office additions covering 24,000 sq. ft. are Holland, Hannen and Cubitts Limited, Howdon-on-Tyne. The architects are Couves and Partners, Grainger Chambers, Hood Street, Newcastle upon Tyne.

**Middlesbrough.** The Tees Conservancy Commission, Queen Street, have accepted the tender of the Demolition and Construction Co. Limited, London, at £1,398,854 for the construction of five deep-water quays at Lackenby. Other work including laying railway lines, providing cranes, offices, and other items, costing a total of £900,000, will be carried out by direct labour.

**North Shields.** Dryers Limited. The contract for the erection of a box factory at Dock Road has been let to R. Frazer and Sons, Hebburn, Co. Durham.

**Scarborough.** Clarkes Aerated Waters and Bottling Co. Limited, Clifton Street, are to erect a factory in Queen Margaret's Road. The architects are Gelder and Kitchen, Alfred Gelder Street, Hull.

**Sunderland.** Brewer and Co. Factory extensions are proposed in Sunderland Street. The builders are G. H. Plemper Limited, Old Chester Road.

**William Doxford and Sons.** Plans have been approved for two-storey offices at the Pallion Engine Works. The contractors are Brims and Co. Limited, City Road, Newcastle upon Tyne.

**Tynemouth.** British Die Castings and Engineering Co. Limited. The architects for factory extensions are G. H. Gray and Partner, 8 Portland Terrace, Newcastle upon Tyne.

**Charles Clay and Son, clothiers.** Plans for factory extensions at West Chirton have been prepared by William Stockdale, 73 Howard Street, North Shields.

**Wallsend.** Holland, Hannen and Cubitts, building and civil engineering contractors, Tyne View Terrace, Howdon, are to erect industrial buildings near Middle Engine Lane, Wallsend.

**Basildon New Town.** Marconi's Wireless Telegraph Co. Limited. The contractors for works extensions are W. & C. French Limited, Buckhurst Hill.

**Basingstoke.** Eli Lilly & Co. Limited.

Plans have been submitted for the erection of a new factory at Kingsclere Road.

**Belfast.** Tolimit Gauges Limited, 16 Peterborough Road, London, SW6. A new factory is to be erected at Dunmurry.

**Birmingham.** C. Kunzle Limited, Five-ways, are to erect a new factory at Garrett's Green Lane. The architects are J. Seymour Harris & Partners, 3-4 Greenfield Crescent, Fiveways.

**Collins & Broadbent Limited,** 28 Longridge Road. A new factory is to be built in Barford Street.

**Blackpool.** Mowbray Building Co. Limited, Cocker Street. A new factory is to be built at Mowbray Drive.

**Bolton.** Wolstenholme Bronze Powders Limited. Extensions are to be made to Springfield Works.

**Black, Taylor & Cowell Limited,** Starkie Road. Works extensions.

**Chelmsford.** E. M. Sears & Co. Limited are to make extensions to their factory at Navigation Road.

**Croydon.** Ferodo Limited, Chapel-en-le-Frith. The architects for the new factory in Thornton Road are Nicholas & Dixon-Spain, 19 Hanover Square, London, W1.

**Stewarts Plastics Limited,** Purley Way. Factory extensions.

## New Factories

**Dagenham.** The factories of Philco Limited, Romford Road and Tubela Engineering Co. Limited, at Fowler Road, Hainault industrial estate, are to be extended.

**Darwen.** Plastocraft Products (Darwen) Limited. Permission has been received for extensions to Whitehall Mill.

**Derby.** Rolls Royce Limited have development plans in hand for a new site at Raynesway.

**Dudley.** Dudley Tool, Jig & Engineering Co. Limited, Tettenhall Street. A new factory is to be erected at Oakewell Street.

**Ealing.** P. Ormiston & Sons Limited, 31a Denmark Road. Existing buildings are to be demolished and a new factory erected.

**Eccles.** Ward & Goldstone Limited. The Bentcliff works are to be extended.

**Edmonton.** M.K. Electric Limited, Park Road, London, N18, are to make extensions to their works.

**Enfield.** Belling & Co. Limited, Bridge Works, Southbury Road. Approval received for extensions to the works.

**Exeter.** E. Pearce & Co. Limited, Shilhay. The contract for the erection of a new factory has been awarded to E. B. C. Sleeman Limited, Longbrook Terrace.

**Fawley.** The American Union Carbide Corporation, New York, are to build a new factory for the production of polythene.

**Hendon.** The Planet Jig & Tool Co. Limited, 17 Colindale Avenue, London, NW9, are to extend their factory.

**High Wycombe.** Cressex Properties Limited are to erect two new factories.

**Ilford.** Glendale Cabinet Co., 555 Commercial Road, London, E1, are to build a new factory at Hainault industrial estate. The architects are Durrant, Westmore and Reeves, 121 Cheapside, London, EC2.

**Leamington Spa.** Neale Wright & Co. Limited, Central Chambers, The Parade, are to build a new factory and offices.

**Lichfield.** J. McLean & Sons Limited, Coven, Wolverhampton, are to erect a new factory.

**London.** J. Cinnamon Limited. The architect for extensions to the works at St. Andrews Road, London, E8, is S. A. S. Yeo, 3 Chesham House, Willesden Green Station.

**Lowestoft.** Robert Shenton, Son and Richards Limited, Wyvern Works, Whapload Road, are seeking a site for new works.

**Manchester.** Benrath Machine Tools Limited, Leestone Road, Sharston. A new factory and offices is to be built at Longley Lane, Northenden.

**Oxford.** Pressed Steel Co. Limited, Garsington Road. New factory to be erected.

**Portsmouth.** Dellagana and Denby are to make extension to their factory at Dundas Lane.

**Redditch.** Lan-Bar Limited, 19 Seymour Street, Birmingham. A new factory is proposed at Arthur Street.

**Sheffield.** Freeman, Oakes & Co. Limited, 16 Fitzwilliam Street, are to erect a new works and offices in Tenter Street.

**Southampton.** South Western Tar Distillers Limited, Totton, are to erect a new chemical works.

**Southend-on-Sea.** Lyndan Press Limited, Sutton Road. A new factory is to be built.

**Walsall.** C. & H. Howe, Gomme Street West, Willenhall, are to erect a new factory at Holly Lane.

**Wednesbury.** Wilkins & Mitchell Limited, Darlaston Road. Plans have been approved for extensions to the works.

**Wembley.** Bratt, Colbran Limited, Lancelot Works. The architects for works extensions are Wimperis, Simpson & Fyffe, 61 South Molton Street, London, W1. Kyle Stewart (Contractors) Limited, Empire Way, are the contractors.

**Windsor.** W. H. Mayes & Son, 5 MacKenzie Street, Slough. Plans have been approved for the erection of a new factory at Arthur Road industrial estate.

**Annan.** The Aircrow Company and Jicwood Limited are planning a sister plant to the Annan factory which they opened some years ago. News of this was given at the opening of the company's new £250,000 plant at Weybridge in June.

**Banff.** A new modern distillery, to be known as Macduff Distillery, is planned for a site at the mouth of the Deveron, at Banff, by Glen Deveron Distilleries Limited.

**Cardiff and Exeter.** Bowmaker (Plant) Limited are inviting tenders for the erection of new branch depots at Cardiff and Exeter.

**Cranley.** British Tabulating Machine Company Limited. Two storey building now being erected.

**St. Helens.** British Oxygen Gases Limited. Construction has begun on a new works.

**Armadale, West Lothian.** Dickson and Mann Ltd. New £50,000 factory to handle the production of mechanical handling plant of all types.

**Douglas.** Hubbard and Setteringham and Mitchell Engineering Company Limited are associated in a new venture to establish a £100,000 pilot plant at Douglas to do coal carbonization and chemical manufacture using gas coal from the Douglas area. The final development will be a £500,000 plant.

**Dundee.** W. G. Grant and Company Limited, 31 Constitution Street, Dundee. Factory extension.

**Dundee Planning Committee** has approved setting up of an industrial redevelopment area in the Blackness Road, Brook Street, Loches Road District.

**East Kilbride.** John Macdonald (Pneumatic Tools) Limited of Glasgow are planning a new factory at East Kilbride.

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**THE proprietor of British Patent No. 603659**, entitled "Power-Lift Attachment For Tractors", offers same for license or otherwise to ensure practical working in Great Britain. Inquiries to Singer, Stern & Carlberg, 14 E. Jackson Blvd., Chicago 4, Illinois, U.S.A.

**THE proprietor of British Patent No. 750963**, entitled "IMPROVEMENTS IN GAUGING APPARATUS FOR USE IN MACHINING AND GRINDING OPERATIONS" offers same for license

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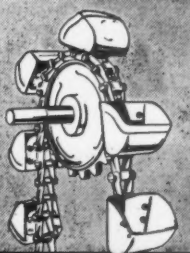






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